THE

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ELECTRICAL REVIEW.

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THE DEMAND THAT WILL FOLLOW.

A NUMBER of our manufacturers are at present making laudable efforts to secure a share in the large electrical trade that will be done with Russia after the war. Their immediate ability to meet the requirements of the market is restricted for various reasons, but for those who are not pre-occupied with other concerns the market presents great opportunities for them to assist our Ally. Everybody electrical now knows that Russia's electrical manufacturing capacity has been very small indeed, and nobody has known it better than German firms, who have done their best to keep it so. Russia has been in the past far too dependent upon those who wished to add Imperial domination to commercial conquest, and her statesmen and her business people too must recognise by now that, if the way had been less easy for that commercial success, the possibilities of the present lamentable state of war ever occurring would have been much reduced. With a manufacturing capacity and a modernised industrial organisation such as her national position and wealth called for, there might have been no shortage of munitions last year giving the enemy an opportunity to demonstrate the superiority of her industrial facilities. The same thing applies in regard to other countries as well, and there may be much heart-searching on this point in all of them before the conditions of a permanent peace are laid down.

It is a serious question of the first magnitude as affecting the entire future relations between great nations as to how far one nation is to so develop its industrial resources as to make them a constant war menace for the rest of the world. The matter is of the utmost importance now that experience has shown us all that war in the twentieth century is so largely a series of engineering operations. The nation with the most extensive engineering works, and with the largest number of trained people earning their livelihood therein, given the facility for securing ample supplies of necessary raw material, may be so prepared for war emergencies as to be able to dictate the policy of other nations. Germany's works of this character are at present practically intact; whether or not they will remain so at the end of the war is quite another question. But whatever happens in that connection the lesson has been learned, and as one consequence we may reasonably suppose that after the war international trade between Germany and Russia will not be resumed on the old basis. Russia, in order to be independent of German electrical manufacturing in the future, must either increase her own productive capacity or she must import increasingly from Great Britain, America, Japan, Sweden, etc. The former of these alternatives has exercised the minds of Russian electrical and other industrial authorities a good deal, and we may expect to see increased manufacturing capacity on Russian soil as time goes on; but as things stand, and until a new and industrial Russia emerges, importation must be relied upon. Leaving our Allies and neutral manufacturing countries out of consideration at present, let us ask what will be the position of British electrical manufacturers in relation to the coming Russian

demand. Some of her writers are blaming us for our past indifference to the market, and are seeking the reasons therefor and drawing their own conclusions as to what may be expected in the future. Granted that a good deal must depend upon Russian national policy in regard to import trade, and the possibility of that policy favouring British traders, we have to remember that British electrical manufacturers are faced with many other problems in regard to the future which are somewhat closely related to the question of their activity in Russia. They are eager to secure the Home market to themselves, also to meet the needs of the Colonies and dependencies, while France and Belgium and Italy desire their assistance, or will do for a time, and there will further be no disposition to reduce their hold on foreign markets in which they already have desirable connections. They may distribute their attentions over all these markets, Russia included, without meeting any of them to the full, but the question that is naturally being asked in some of these other countries is, how far it will be possible for them to depend upon British industry if they make plans for trying to prevent enemy trading within their borders. Will the character of British products be adjusted to meet their requirements? Will British manufacturing or productive capacity be increased to any large extent? We believe that to both of these questions the answer is emphatically in the affirmative, but will the capacity be sufficient to justify other nations in basing international trading policy upon possibilities in this direction? As our deliberations on after-the-war trade policy proceed we may expect such questions to be more and more searchingly asked and discussed by our Allies, and it is as well that we should consider the matter as calmly and carefully as we can in readiness. We may be as anti-German in sentiment as the horrors of this war compel us to be, but the fact will remain that, if in any country whatsoever other nations cannot suitably meet the requirements of purchasers, the trade will go to those who are in a position to do it, and who are not merely in that position from a manufacturing capacity point of view, but are eager to employ every possible means of adaptation and enterprise within their power to attain that end.

We have been led to make these remarks more particularly by an article which has appeared in *Elektrichestvo*, of Petrograd, on the prospects of future electrical business between Russia and England. There is so much of interest in this article that we quote from it fairly fully elsewhere in this issue. The author is Engineer P. Gurevitch. We suggest that his contribution might well be made the basis of a very serviceable discussion. It is well that we should see ourselves as we appear in the eyes of a friend, but he offers certain criticisms to which we are sure our manufacturers could effectively reply. He suggests that British electrical manufacturers will lose certain markets because Germany, being out of favour elsewhere, will concentrate her energies remorselessly upon those markets, fighting us with the old weapons of low prices and long credit until she succeeds. Taking this, we think too readily, as accomplished, M. Gurevitch uses it as an argument why we should display our utmost enterprise in seeking new markets—especially in Russia. We do not believe that British electrical and engineering firms need much more urging at this particular moment to display enterprise in Russia. The war has roused many of our trading interests from their former lethargy, and the future will be different from the past in that respect or we are greatly mistaken. It will be different for our enemies also. The condition of affairs in Germany at this moment, and the more serious position that is inevitable, do not, in our opinion, suggest that we shall be defeated in the future by the long credit given by Teutonic firms. Further, if we are to meet the demand we must be to some extent assured concerning the inducements. Our electrical confrères in Russia should see to it that their arms are not so wide open to German electrical firms in the future, and that German financiers and electrical organisations are not so privileged in the facilities granted to them. They should also bear in mind that there are other difficulties beside that of the language and demands for long credit that have led some British traders to be disinclined to operate in Russia. M. Gurevitch has something to say regarding the bad reputation of some Russian business people. Much is to be gained by the promotion of a spirit of confidence and trust between the trading communities of our two great nations. The war has brought about a better understanding between us, and the mutual sacrifice that we are making in the cause of world civilisation will, we trust, be followed by mutually satisfactory fair and square commercial dealings which shall be uninterrupted for a generation. Electrically we shall play our part up to the limit of our enlarged capacity. Labour problems, especially the prospects of "dilution" being continued after the war, the employment of women, and the abandonment for ever of limitation of output, have much to do with this question of future capacity. Assuredly the worker requires educating as to the importance of the effect of these matters upon the future trade of the Empire, and of the promotion of desirable commercial relations with our Allies. Of course, our manufacturers will weigh up in good time the question of that capacity, and we hope that they will accommodate themselves to all the coming markets of the world according to the developments in the situation. But we hardly think that they will be inclined to relax their hold upon a market where they can do good business, and where the possibilities are immense, until they are assured of success in another that is offered to them. However much they may welcome good desires and believe in anti-German sentiments, they will require to know more about the Russian Government's policy for excluding German electrical manufactures. On the other hand, the Russian Government is not likely to deprive German traders of facilities if by so doing it is going to affect adversely Russian developments; therefore, it is not unlikely that it will want to know something about British, Allied, and neutral manufacturing capacity. The situation is not an easy one to deal with, but the details will inevitably hang very largely upon the broad principles which are adopted by the Trade Conference of the Allies—if the war position is such as to enable any definite conclusions to be reached when that conference takes place.

Lead. The lead market has preserved a wonderfully steady tone, and there was hardly any change in values even when it became necessary to sell some fair quantities of lead which had been loaded for Russia many weeks ago, the vessels containing which had not left British ports. The demand continues distinctly active on account of the home trade, but there has not been much doing generally in connection with the export markets, although within the last few days a few inquiries have been met with from Russia for April-May shipment. At the present time the White Sea is frozen up, and no more shipments are likely to be made to Archangel until the route is pretty free from ice. A good deal of lead has been imported lately, and thanks to this there is a plentiful supply of metal for early delivery, but demands have been good enough all along to absorb everything reaching here.

The position depends very largely, no doubt, upon shipping conditions which have become abominably muddled. The monstrous charges and hopeless muddle at ports, combine to put out of effective operation all economic factors tending to relieve the position, and it seems to be

nobody's business to direct matters with the smallest degree of commercial intelligence. Probably things have about reached their limit now, and there seems to be a faint hope entertained in some quarters that "something will be done." It is absurd to look for any change for the better until a little common sense is brought into play, until the vessels lying rotting on account of ineptitude are made use of, until steps are taken to control the extravagance and waste in connection with official chartering, and until arrangements are made for discharging vessels when they do arrive. So far the promises of improvement which have been made have been entirely illusory, but if conditions were changed in this respect there would soon be an end of the extravagant prices everywhere demanded for commodities, and the sooner the situation is handled with a few grains of common sense the better for the nation at large.

The advices coming to hand from Mexico suggest a distinct improvement in the mining position there, and this is all to the good, for, as Messrs. James Forster & Co. point out, Mexico produces in normal times 120,000 tons a year, or about 10 per cent. of the world's lead production.

Fatality in the Bath.

The fatal accident recorded in our last issue affords a grave warning of the danger of a little knowledge in connection with electrical affairs. It is very well for the young tyro to experiment with electric bells and pocket lamps, or anything else that can be fed from primary cells, but when he tampers with conductors connected with the public mains he is embarking upon an enterprise which may have disastrous results. This is well understood in the case of gas and water supplies, which have been with us so many years that the public thoroughly understands its position with regard to them and the dangers which follow ignorant and unskilful tampering with the pipes and fittings; electricity, however, is comparatively a newcomer, and has not yet acquired the respect of the ambitious schoolboy anxious to demonstrate his cleverness.

It is true that in the case in question the combination of circumstances happened to be exceptionally favourable to the prospects of disaster, and was probably unique—may it remain so. In ordinary circumstances the lamp might have remained in use for years without mishap. But the flexible cord was held in place only by tacks, and when the boy, in haste to extinguish the light, seized the hot bulb instead of the switch, apparently in dropping the lamp he jerked the flexible off its frail supports.

The moral to be drawn is that on no account should any unqualified person be permitted to meddle with the wiring of electric lighting installations. The bathroom especially is the very last place in which foolhardy experiments should be allowed.

Tapping Blast Furnaces.—At the Edgar Thompson works of the United States Steel Corporation, blast furnaces are tapped by a method devised by the engineering department of the Westinghouse Electric and Manufacturing Co.

An electric arc is drawn between an electrode and the chilled metal in the tap hole; the heat of the arc burns through the chilled metal, until the fluid contents of the furnace are reached. If during the opening operation non-conducting material is encountered, it is necessary to stop the arc and drive a steel bar through this mass. The process of melting is then continued, the arc following this bar of metal.

A 250 volt circuit is used, the pressure being reduced by means of a water rheostat. A current of from 800 amp. to 1,000 amp. is ample for the operation. The apparatus required consists of a special electrode holder, electrodes, cable, a resistance, and a head shield or protector for the operator. The electrode holder consists of an iron pipe 4 ft. or 5 ft. long, in one end of which the electrode material is placed and clamped by means of a ring; the end of the pipe is split in order to give a clamping effect when the ring is forced down towards the end of the pipe. In the other end of the pipe a wooden pole is placed, the cable connection being made to the iron pipe. The entire length of the electrode and its holder is about 12 ft.

INCREASING THE TRAFFIC CAPACITY OF TELEGRAPH LINES BY ACOUSTIC TUNING.

The usual connections for D.C. telegraphy with Morse sounders are subject to the disadvantage that with closed-circuit or with open-circuit working, so long as communication is in progress between two stations, all intermediate stations must remain idle. On a line with many intermediate stations, this naturally involves great delay, particularly during busy hours, and a line which is ample for the average daily traffic may be hopelessly inadequate during the rush hours. The two main methods by which the traffic capacity of a telegraph network may be increased are (1) by increasing the average capacity of the transmitting and receiving instruments; (2) by increasing the message capacity of the line—*i.e.*, by using high-speed instruments and multiplex working respectively. High-speed instruments are generally fairly complex, and must be served by a crew of skilled operators, so that they are chiefly limited to long-distance main lines, with high traffic density during a large fraction of each day. Multiplex working also shows to best advantage only when traffic is dense, but the apparatus used is little more complex than for ordinary one-direction working, and no special preparation of messages is required. Combined high-speed and multiplex working is particularly adapted to the interchange of messages between two large towns, and offers nothing to the solution of the problem of maintaining free intercommunication between all possible pairs of stations on a line dealing principally with local traffic of this nature.

A system facilitating such intercommunication must be

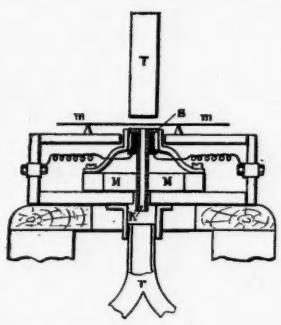


Fig. 1.

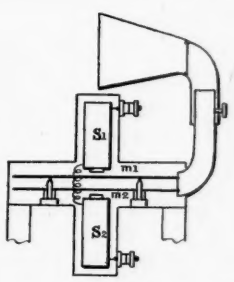


Fig. 2.

infinitely flexible, *i.e.*, permit simultaneous communication between any pair of the series of stations served, and it must involve only apparatus which is reasonably cheap to install and quite simple to operate. Recent advances in the use of alternating currents for signalling purposes suggest that the principle of variable-frequency tuning might be used to advantage in developing simultaneous signalling without interference over a single line. Dr. Oscar Srnka, of Brunn, has recently devised a multiplex system on this principle, using alternating currents of different frequencies on the same line and passing through all stations on the latter, but each frequency affecting only that receiver tuned for its reception. The sender, receiver and auxiliary apparatus at each station are connected in series with each other and with the line, and each station is allotted, for reception purposes, a definite A.C. frequency. Giving suitable arrangements for sending signalling current of appropriate frequency into the line, this system eliminates waiting (except where a station is already engaged), and gives each station access to all the others at all times by a single line.

For reasons given later, it is convenient to keep the frequencies used between, say, 600 and 1,100 cycles per second. With a difference of 50 cycles (*i.e.*, 600, 650, &c.) 11 stations per line are possible between these limits, and if this be not sufficient, 14 stations can be operated by reducing the difference in frequencies to 40 cycles. A smaller difference is not desirable, since 40 cycles at 1,120 cycles represents only 4 per cent. difference, and this is as low as it is safe to go without endangering accuracy in selective working. If more than 14 stations should be desired on

one line, the best solution is to extend the frequency range above 1,000, or below 600 cycles. To prevent confusion by harmonics, the even progression of frequencies should be broken, say, by the use of 1,250 instead of 1,200 cycles (which would probably confuse with the 600-cycle messages); 1,350 instead of 1,300 cycles (which = 2 × 650 cycles), and so on. This also provides a greater percentage difference between the several frequencies, and makes working safer in consequence.

The apparatus employed consists of a "mono-telephone," or tuned A.C. telephone (fig. 1) for reception, and an adjustable, variable-frequency "singing telephone" for transmission purposes. The mono-telephone responds vigorously to alternating current of the frequency for which it is tuned, but is practically unaffected by alternating currents of other frequencies. In the sketch, which is based on a drawing in *Elektrotechnik*, a steel membrane *m* (1 or 2 mm. in thickness) rests on three fine points set 120° apart round the nodal line of the fundamental wave—*i.e.*, on a circle of diameter = 0·68 × the diameter of the membrane. A powerful magnet M has an iron core K carrying a fine wire winding *s* of 200 to 400 ohms resistance. The core K is hollow, and to it is connected a forked tube *r* leading to the telegraphist's head-piece receivers. Both the operator's hands are left free; the monophone is protected by a glass bell jar.

An ordinary telephone receiver with rim-fixed membrane responds to all frequencies, but a membrane supported as in fig. 1 responds freely only to a frequency identical with its own natural frequency. The latter depends on the

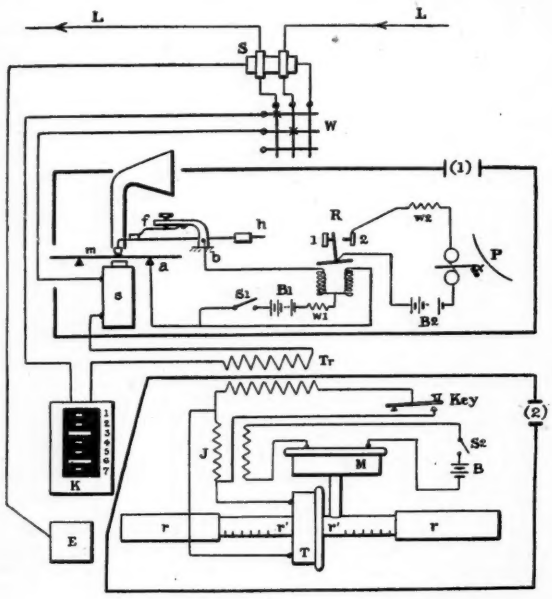


FIG. 3.

diameter of the membrane, and it is thus possible to make monophones to respond to any desired frequency, this frequency being constant throughout the life of the instrument, *i.e.*, *no frequency adjustment being required in ordinary working*. Though, in practice, the monophone membrane *will* respond to others than its exact natural frequency, it does so very weakly, and the difficulty is not to pick out the loud signals intended for the station concerned, but to read the faintly-reproduced signals belonging to other stations, even supposing one wished to do so. By placing a closed resonance tube T over the centre of the membrane, the fundamental note is rendered yet more pronounced, and there is no possibility of mistaking it. For frequencies of 1,100 and 600 cycles per second the wavelength of sound = velocity/frequency = 33,300/1,100 or 600 = 30·3 or 55·5 cm.; and the length of the tube T (closed at upper end) = wave length/4 = 7·6 to 13·9 cm., which is quite a convenient range of dimensions.

It should be noted that the tuning of the receiver is entirely mechanical and accoustical—there are *no tuned circuits*, involving complex construction and needing more or less skilled manipulation. Once built, the monophone should need no further adjustment.

To eliminate the necessity for a head-piece receiver, a loud-speaking monophone may be built on the principle illustrated in fig. 2, using two membranes actuated by two magnets and supported respectively on cork and on steel points, the lower membrane being drilled to admit the pins carrying the upper membrane. A horn with telescope tube for acoustic tuning, and a thin elastic diaphragm for dust-exclusion, complete the apparatus. Where a permanent record of messages is required, a mono-frequency relay, in combination with a differential relay, operates a printer, the arrangement being as shown inside rectangle (1), fig. 3. In this diagram, *m* represents a monophone membrane (as in fig. 1), actuated by the relay coil *s*. A nickel-silver contact-plate at the centre of *m* makes contact with a rounded contact piece on a light and delicately pivoted lever *h*. The latter is counterweighted, so that it has a frequency of swing slightly lower than that of *m*, but does not affect the natural frequency of the latter. During idle periods the adjustable spring *f* (fitted with a felt pad) holds the lever *h* lightly on to *m*, so that a closed circuit is maintained between the points *a b*, and the differential relay R keeps the position shown. When, however, a signal sets *m* swinging, the lever *h* is not able to keep exactly in step, its contact with *m* becomes imperfect, and the relay R, therefore, closes contact 2, and so completes the local printer circuit B_2 w_2, and the signal is printed on P. Adjustment is effected by a screw setting the position of *s*, or by shunting the coils of the latter; the relays are placed under a dust-tight cover, and mounted on a rubber block to absorb external vibrations. By adding a resonance tube the monophone relay can be adapted for audible reception as well as, or instead of, giving a printed record; when receiving by sound the printer is stopped, and the switch S_1 opened.

So far only incidental mention has been made of the apparatus used to produce the frequency required for signalling to a selected station. Each station must be able to produce with ease and certainty A.C., at all the frequencies required by the $(n - 1)$ other stations on the line. The apparatus used for this purpose must be reasonably cheap and compact, and it must be reliable and simple to manipulate. Tuned buzzers might be used, but a battery of them to supply ten or a dozen definite frequencies would be costly, take up a good deal of room, and need more skilled attention than can be counted on in a country telegraph office. Toothed-wheel high-frequency alternators run at variable speed offer another solution, but the difficulty is to provide means for maintaining speed constant at the desired value, particularly where there is no ordinary electricity supply available to serve a driving motor. The Larsen acoustic, variable-frequency A.C. generator offers a simple, inexpensive and technically satisfactory way out of the difficulty. The generator yields a nearly sinusoidal current, and therefore sets up clear musical tones in air. In the rectangle (2), fig. 3, a singing telephone T is provided back and front with tubes r^1, over which slide tuning tubes *r*; the telephone is coupled electromagnetically to a microphone M by the induction coil J. By varying the setting of the tubes, the frequency of the A.C. is controlled; for any particular setting, the frequency of the current delivered by the secondary of the induction coil is constant within a fraction of 1 per cent., and falls normally between the limits 600 and 1,100 cycles per second, but can be made higher if there is a specially large number of stations on the line. The positions of the tubes *r* corresponding to predetermined frequencies are naturally determined once for all, and marked on the tubes themselves.

Fig 3, as a whole, shows the complete lay-out for an intermediate station. The through-line L is connected, *viâ* the lightning protector S, to the change-switch W and the station apparatus. The receiver gear (in rectangle (1)), is adapted to audible or printing reception, and by connecting a second monofrequency relay to the terminals *a b* (or possibly just by using a second membrane beneath *s*), the second relay or membrane being tuned to the same (special) frequency in each station, provision may be made for simultaneous reception throughout the system of time signals, weather reports and other official intelligence. The transmitter, in rectangle (2), is connected to the line through a transformer T_r and

frequency meter K of the vibrating reed type. This meter indicates whether a station with which it is proposed to communicate is already engaged; in the case depicted, the meter shows stations 3 and 6 already engaged. The whole equipment is compact, simple to operate, and not unduly expensive. For use under average conditions on lines with 10 to 15 intermediate stations, it seems to be of distinct interest.

MODERN PRINTING TELEGRAPHY.

Discussion at Edinburgh.

The paper on "Modern Printing Telegraphy," by Mr H. H. Harrison, was read before a meeting of the Scottish Local Section of the Institution of Electrical Engineers at Edinburgh, on Tuesday last week. The meeting was largely attended by members of the telegraph staff of the General Post Office in Edinburgh.

Replying to Mr Turnbull (Edinburgh), who asked if anything had been done to connect electrically two typewriters, so that the operator at one end could work with his vis-à-vis at the other, Mr. Harrison explained that the London and Manchester circuit had not less than hundreds which were controlled when transmitting with one operating line wire. Mr. M'Gregor (Edinburgh) cited a case where a civilian telegraphic staff had been very considerably reduced—*i.e.*, in the *Scotsman* office in Edinburgh. He explained that there they had had three wires, but that now they worked with the Creed system upon one line. The saving in cost of maintenance, &c., would be great. There were now two or three operators against five or six. The apparatus was bought outright at a cost which would in three or four years be covered by the amount saved in the wages of the operators who had been dispensed with. Mr. Dankes (Edinburgh) agreed entirely with the author that Morse signaling could not go out of use, as the present war had shown that there was no system to approach the Morse. In the commercial world, however, the Murray-Baudot had points to commend it.

In the course of his reply, Mr. Harrison, in answer to Mr. M'Gregor, said he took it that in the case he had cited the Creed wire was not always running, and that occasionally there were corrections and service instructions to be sent. While it was possible to work with Creed on the staff as Mr. M'Gregor had suggested, and with no knowledge of Morse, it would be awkward if any mishaps occurred. He imagined, therefore, that a Morse operator would still be needed in an establishment with a Creed installation only. As to driving, his opinion was that the weight-driven transmitter was a very good form if they made the motor large enough; he imagined that many, including those in post offices, were on the small side. He was inclined to think that transmitters and reproducers on the Creed system should be driven by the phonic wheel.

Discussion at Manchester.

Mr. Harrison's paper was also read and discussed by the Manchester Local Section on January 25th.

Mr. W. J. Medlyn said that in Manchester the Murray and Western Electric Co.'s printing systems were used, whilst Liverpool used the Siemens and the Baudot systems. The Wheatstone automatic and the Creed reperforator and printer were also used at both the above centres. On the Murray and Western Electric apparatus in Manchester, operators had no difficulty in typing at the rate of about 50 words per minute, and thus keeping well ahead of the automatic transmitter running at 40 words per minute. In Manchester, specially prepared ink rollers were used, and the printed tape or page print was afterwards run through a copying machine in order to produce a duplicate for departmental purposes. The printing of a duplicate by the telegraph apparatus itself would, if possible, effect a considerable saving. The high-speed one-channel automatic printer appeared to have a disadvantage in the delay experienced in obtaining repetitions or correcting errors of transmission. Questions had first to be perforated on one of the sets and then wait their turn for passing through the common transmitter. The required reply suffered delay at the distant end through the same reasons.

Mr. A. Brooker said the printing telegraph practice of the future was apparently to be based chiefly upon the work of Hughes and Baudot. The valuable work of the Post Office engineers had to be recognised, particularly in duplexing printing telegraphs. It was not fully appreciated even now that a differentially wound instrument, although balanced to a steady current, was not necessarily so to transient currents; in fact, an instrument could hardly be made truly differential to transient currents of different duration and voltage. The author had issued a warning to inventors who tried to produce signals by varying current strength; if he held the opinion that even with perfectly insulated lines variable-current methods were not going to succeed, it would be well if the warning was more definite and reasons given.

Mr. T. E. Herbert said, regarding the author's statement that the typewriter class of printer would survive, that Murray constructed a special typewriter with a very short type-bar and ball bearings, with a view to increasing the rapidity of the machine. The final result was a speed of about 200 words per minute. The recent telegraph of Siemens claimed a rather higher speed with the aid of the type-wheel. He was not convinced that the type-bar would eventually survive the type-wheel. In designing his own machine the author had adopted a type-wheel. There was a simple form of type-printing telegraph (constructed by Siemens) in extensive use in Germany, and it would be remembered that in this country the Steljes admittedly failed, because it was badly constructed; had the construction been better, it would have been in extensive use to-day, and, as things stood, there was nothing to replace it for short-distance work.

Mr. T. Plummer said that in Birmingham the duplicating of messages had been abandoned. Only one copy was prepared, which was passed on to the public, but certain particulars embodying number of words, address, times, &c., were recorded on a portion of the message form, which could be detached and retained. The old method of taking carbon copies had apparently been abandoned, in which case one of the great difficulties of inventors of printing telegraphs had been removed. Birmingham had two sextuple duplex Baudot sets working to London in place of four quadruple and four duplex sounder circuits. The Birmingham-London cable was underground, paper-insulated, and the four quadruple sets were worked on loops, *i.e.*, without any earth connection, and on the top of the loops the four earthed duplex circuits were superimposed. The old arrangement gave 12 channels working in either direction between the two cities, and these 12 channels, which formerly took up eight wires, were now being provided by the two Baudot septuple duplex sets, taking up only four wires. The new arrangement released lines for extension to other towns. A trial was made recently to find what the Baudot sets could do, and the record, Birmingham to London, was 849 messages finished and disposed of in an hour. Since this traffic did not keep the instrument fully employed, the figure could not be taken as the maximum possible.

Mr. G. C. Morris said that when contrasting the single-channel high-speed with the multiplex low-speed instrument, a point to be borne in mind was the speed at which the printed tape could be gummed on message forms and checked. Gummers and checkers all worked in one group with the high-speed instrument, and there was only one tape to be gummed; the work could, therefore, be easily distributed amongst the group, and the size of the group varied according to the speed. With a multiplex, however, one gummer was required for each channel. The transmitter also had to be considered, and the speed of the channel had to be adjusted to give both ends suitable loads. An electrical combiner consisting only of relays coupled with a rotating type-wheel offered the best solution of many mechanical difficulties. Regarding the use of perforated tape as a reservoir of signals, although this had been employed for many years it was far from satisfactory. The difficulty in making punches to work rapidly and accurately was surprising, and worn punches and dies were often a source of stoppage. Paper of variable thickness also contributed to the faults. With Col. Squier's sine-wave method of telegraphy, all fine printing signals might be sent simultaneously on one segment, and suitably sorted out at the receiving end, using tuned circuits. If so, the speed of circuits would be enormously increased.

Mr. F. D. Latimer drew attention to the invaluable pioneer work of the late Mr. Fred. Higgins, of the Exchange Telegraph Co., and said that the relays of the Exchange Telegraph Co. were not situated at the receiving end, nor were they polarised; they were sufficiently sensitive, however, to respond to the current impulses at the rate of about 2,000 per minute. In practice it had been found that in a transmitter running at 100 revs. a minute, the electromagnets had an "apparent" ohmic resistance of approximately nine times the actual ohmic resistance, consequently the operating current was only one-ninth of that under steady current conditions. Some years ago the Exchange Telegraph Co. maintained about 700 financial recording instruments scattered throughout London, and all controlled by one operator stationed at the central offices in Cornhill.

The Author, in reply, said that the type-bar translator was the only satisfactory translator which would make duplicates, but the one difficulty in making duplicates with the printing telegraph was that of feeding in blanks. The only practical way seemed to be to take press copies. The automatic suffered in the matter of delay in dealing with corrections. Hughes showed excellence in the workmanship of his printer, while Baudot put forward the correct alphabet, namely, the equal-letter alphabet. It was fair to state that Baudot founded the system of modern printing telegraphs. An objection to varying the current strength for signalling purposes, quite apart from its use on overhead lines, lay in the fact that, in order to produce a suitable alphabet, it required to be an unequal letter alphabet which could not be multiplexed. Generally speaking, it was better to keep away from a system depending on variable-current strength. In the author's opinion, a type-bar translator would give excellent results when worked at 45 or 50 words per minute, or even higher. Regarding type-wheels, he did not think a shaft material could be produced which would stand a speed of 45 or 50 words per minute for any reasonable length of time without shearing. In America, artillery fire control was actually carried out by means of a rather primitive and simple form of printing telegraph using only 16 letters.

National Business Organisation.—The Institute of Industry (of Great Britain and Ireland), Ltd., has appointed a Special Committee of its court of directors to meet representatives of important trade interests, with a view to considering suggestions having for their purpose the strengthening of the court of directors, and the co-operation or amalgamation of other similar movements.

JOHANNESBURG ELECTRICITY SUPPLY.

At the meeting of the South African Institute of Electrical Engineers on November 18th, 1915, Prof. J. H. Dobson, M.I.E.E., read a paper on the distribution plant of the Johannesburg Municipal electric supply system, of which he is the engineer and manager. The following is an abstract of the paper :—

The municipal area of Johannesburg is over 80 square miles in extent, and is one of the largest of its kind in the world. Electricity is supplied for domestic, industrial, and tramway purposes, there being nearly 20,000 meters on the system, and the annual output being over 25 million units. In 1886, when gold was discovered on the Witwatersrand, the township had a population of 50, which grew to about 3,000 in 1887, and in 1914 had reached 253,274. After the Anglo-Boer war in 1902, Messrs. Mordey and Dawbarn were appointed consulting engineers to the Council, relinquishing their connection with the Council in 1908.

The consulting engineers adopted three-wire D.C. supply at 230-230 volts for the inner area, 3-wire single-phase A.C. at 200-200 volts for the outer area (feeders at 3,300 volts, single-phase, one pole earthed), and 575 volts D.C. for traction. The two voltages for lighting supply cause some annoyance to consumers who move from one area to the other, and the generators being two-phase, some difficulties are experienced in balancing the phases.

The author joined the municipal service in 1909; at that time there were ten feeding points, to which two have since been added. The feeders were single-core cables of 1 sq. in. section (neutrals 0.5 sq. in.), insulated by prepared paper, vulcanised bitumen, and impregnated tape, with two layers of steel armouring, jute served and compounded. The distributors were triple-concentric cables paper-insulated, lead-covered, jute served, and double steel armoured, jute served and compounded. At each main feeding point was a feeder box in the pavement, containing three-wire bus-bars on porcelain insulators, the box being filled with diatrine. Similar boxes were used at the junctions of distributor and sub-distributor cables. Each feeding area was fed by one feeder and was entirely independent of the others; the cables were coupled with studs and links, so that on the occurrence of a fault the whole feeding area was cut off, and the fault had to be localised by disconnecting and reconnecting the distributor cables in the feeder box, causing loss of time.

The system had to be entirely reorganised, owing mainly to frequent interruptions caused by faults on the D.C. feeders. Owing to the vulcanised bitumen becoming soft and plastic, the whole of them decentralised at loads of less than 600 or 800 amperes per square inch—in some cases less than 400 amperes. The insulation resistance of the cables dwindled away, and short-circuiting between the copper and steel armouring was a regular occurrence. "Such a state of feeder cables, attached to a system as has been described and coincident with the failure of the gas engine scheme, made conditions absolutely appalling."

Financial considerations required that the best arrangements had to be made of the existing cables, and the reorganisation of the system occupied several years. The feeder cables were picked up, stripped of all the armouring, and relaid on the solid system in glazed earthenware troughs with proper bridge pieces, the troughs being filled with bitumen and covered with bricks. First an additional feeder was run to the centre of the town, so that the feeders could be relieved one by one; the additional feeder was eventually absorbed by the growth of the load. Nearly all the pavement boxes were discarded; underground chambers were built at the feeding points, and feeder pillars at the sub-feeding points. Two or more cables pass each feeding point, with three exceptions, and provide a duplicate or triplicate supply. Isolating switches enable the distributors to be quickly disconnected from the bus-bars when necessary. Direct telephone communication with the power station is provided.

At the chief sub-feeding points, feeder pillars have been substituted for the surface boxes, with isolating switches. Wherever it is possible, duplicate supplies have been provided.

The alteration in the "inner area" took three years to carry out, and little or no trouble has been experienced since the changes were made. The insulation resistance of the feeder cables, however, is relatively low. Joints in the distributor cables were originally made in cast-iron boxes; faults frequently occurred in these, and in such cases the joints have been remade without boxes. Service joint boxes are eliminated as far as possible by running back important services to chambers each dealing with four blocks of buildings.

The "outer area" is supplied with single-phase current at 3,300 volts, transformed down to 200-200 volts three-wire, distributed by underground and overhead networks; an exception is a new industrial area, which is given a three-phase four-wire supply. The high-pressure cables are two-wire concentric paper-insulated and lead-covered, the inner core being insulated for 3,300 volts and the outer, which was earthed, for 500 volts. They were laid on the solid system, and terminated in kiosks containing transformers and switchgear. The high-pressure cables were looped into the kiosks and bolted to the terminals without disconnecting links; in some cases six or seven kiosks were all connected to the same cable without means of disconnecting whilst the cable was alive.

The type of cable and method of laying were quite good, but unfortunately two high-pressure cables often were laid in the same trough, and experience proved that a fault on one cable often affected the other, thus doubling the extent of the damage and the magnitude of the interruption of supply. Locating a fault, with the high-pressure cable bolted hard on to each transformer, was a very lengthy process, especially as there were no easy means of splitting up the high-pressure cable into sections. There were certain disconnecting boxes where high-pressure cables branched, but excavation to the boxes and melting out the insulating compound took hours of labour. Generally, to restore supply took a day or more. Replacing the high-pressure fuses in the transformer kiosks when the high-pressure bus-bars were alive was very dangerous, and the only alternative was to put all the districts served by the cable in darkness until the fuses had been re-inserted. The fuses were of faulty construction, and there were no interconnections on the low-pressure network. From the operative point of view, the transformer kiosks were "veritable death-traps."

The system was reorganised by the installation of link chambers and pillar boxes for high-pressure cables, the linking-up of high-pressure mains to form ring mains, the grouping of transformers, the replacement of certain of the iron kiosks with brick transformer houses, and the installation of proper control gear in all transformer kiosks. Where several feeders run in the same direction for considerable distances, they have been provided with link chambers which enable any of the outgoing cables to be fed from any of the incoming cables, and provided with circuit-breakers. These arrangements have proved of immense value in dealing quickly with cable faults; and similar arrangements on a minor scale have been carried out in pillar boxes. In several cases the high-pressure cables have been joined up to form ring mains. Several sub-stations have been built in which the transformers have been centralised and provided with switchgear, which facilitates the maintenance of continuity of supply, better pressure regulation, and economy in core losses. In all iron kiosks which have not been replaced by transformer houses, suitable switches and fuses have been provided on both the high-pressure and the low-pressure sides.

The three-phase four-wire power supply to Newtown is derived from the two-phase system by the Scott method at 400 volts.

The tramways comprise a total of 42.29 route miles, 66.17 track miles, and are supplied with direct-current by underground cables up to two miles from the centre of the town, after which the feeders are carried overhead on the tramway poles. The original feeder cables are of the single-conductor leadless type, bitumen-insulated, with a layer of paper next to the copper and jute serving outside the bitumen. They were laid on the solid system, the best for the purpose where atmospheric disturbances occur, the path to earth from the copper conductor through the bitumen insulation and filling and the trough being a long one. Unfortunately, a telephone cable with earthed lead sheathing was laid in the same trough as the feeder, and the latter was connected with the trolley line through fuses by lead-covered cables in the tramway poles; the phenomenal storms experienced in Johannesburg quickly found out these weak spots. The telephone cable system became alive at 500-600 volts, and was rendered useless; the traction cables broke down to the earthed lead sheathing of the telephone cables, causing long stoppages, and the line connections were pierced where the lead sheathing touched the poles. To relieve the system from such troubles, all the paths to earth that could be got at were cut out, the telephone cables were pulled up whenever possible, insulated cable without metallic sheathing was substituted for the line connections, and British Westinghouse lightning arresters were fixed at quarter-mile intervals on the overhead equipment. Porcelain insulators replaced the original compressed-fibre insulation of the trolley line, and have stood up well against the severest electrical storms. Disconnecting switches have been installed on the line connections, and arrangements have been made to link up the feeders and to confine the area of stoppage due to a breakdown to a minimum. Whereas formerly some portion of the tramway service was interrupted during every storm, such interruptions have been almost wholly eliminated.

The tramway system as originally laid down was hampered by no Government regulations, and naturally, therefore, no precautions against electrolysis by stray currents were taken. In 1913 the Government formulated regulations practically identical with those of the British Board of Trade, necessitating the partial reorganisation of the traction supply and the erection of rotary-converter sub-stations at three points, fed with two-phase current at 3,300 volts. The secondaries of the single-phase transformers are double Scott-connected, with two distinct windings, to give a six-phase supply to the A.C. side of the rotaries, which are provided with starting motors and are self-synchronising.

The public street lighting of the inner area was originally carried out with arc lamps, nine in series, but was unsatisfactory owing to frequent faults on the cables, which were rubber-insulated and lead-covered, laid direct in the ground without protection. An average of at least four faults per week occurred on these mains, and in wet weather five or six sometimes took place in one day. The cable being hopeless, the arc lamps were temporarily replaced by large half-

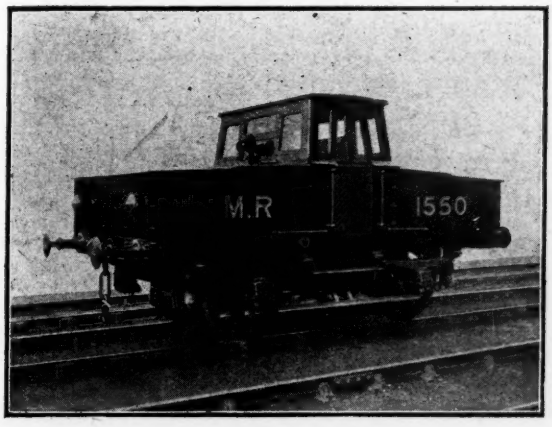
watt lamps or clusters of ordinary metal-filament lamps fed by new steel-armoured cables from the mains. A complete scheme of arc lighting with centralised control has been devised, but lack of funds prevents its being carried out.

From 1909 to 1914 the number of connections increased from 5,720 to 16,091, and the total units consumed from 11.3 millions to nearly 25 millions; the maximum load from 5,400 to 10,900 KW., and the number of street lamps from 5,340 to 7,400. The undertaking is equal in point of magnitude to the whole of the other municipal undertakings in South Africa.

AN ELECTRIC BATTERY LOCOMOTIVE.

Some eighteen months ago the Midland Railway Co. put to work a battery-operated electric locomotive for shunting and sorting the coal traffic in the West India Dock Depôt, London, which investigation showed could be performed more satisfactorily and economically in this way than by horses, hydraulic or electric capstans, and snatch-heads. As the ordinary steam locomotive cannot enter the yard, the whole of the work had to be performed by the electric locomotive.

The maximum speed attained with full load is about seven miles per hour, speeds up to 12 miles per hour being attained with light loads; the rated capacity of the locomotive is six



Electric Battery Locomotive, Midland Railway.

loaded wagons weighing 15 tons each, and 12 light wagons of approximately six tons each.

The weight of the locomotive complete with battery is 17½ tons, and the wheel base, which is, of course, rigid, is 8 ft. 6 in.

The general appearance and method of construction of the locomotive is well shown in the accompanying view. It is fitted with two 22-H.P. motors—one per axle—supplied by Messrs. Dick, Kerr & Co.

The battery, which is situated in the two end compartments, was provided by the D.P. Battery Co., and consists of 108 cells, 21-plate T.L. type, with a capacity of 300 ampere-hours. The cells are the D.P. standard train-lighting pattern in lead-lined teak boxes, and are fitted with "block" type lids.

The locomotive has not been out of service at any time on account of the failure of the battery, and no single cell has failed since put to work about 18 months ago. The battery has been in daily use (except Sundays), the discharge rate varying from 40 to 90 amperes, with occasional spurts up to 150 amperes.

The battery is charged every day from about 12.30 p.m. for one to two hours, and a "refreshing" charge is given in the early morning.

When the battery was cleaned out the work was done without interrupting the service in any way, and the plates were found to be in excellent condition, despite the severe jolting occasioned by continual shunting of the coal wagons. Out of over 2,000 wood separators in the battery it was found necessary to renew only about three dozen, and only very few ebonite sheets were split. This is partly due to the careful suspension of the truck, and also to the tough qualities of the accessories. The four-bar bottom block on which the plates stand, a special feature of the D.P. cell, proved its worth; no shorting had taken place, and there was no indentation, as the weight is better distributed than on the two-bar blocks.

The control is by the ordinary series-parallel method, providing two economical running speeds, but no restrictions are put on the drivers with regard to the use of the other notches; the braking is of the rheostatic type operated by the main controller, this method being very useful for shunting operations. A band brake with hand operation is also fitted to each axle, being equivalent to the tender brake on steam locomotives.

The mechanical portions of the locomotives are largely constructed of standard wagon parts, *e.g.*, the wheels, axles, draw-gear, &c. The body and cab are of wood, suitably braced with ironwork. The covers over the battery compartments are arranged to drain off all rain water, while both sections are so ventilated that gases given off during charging or working the battery are carried off.

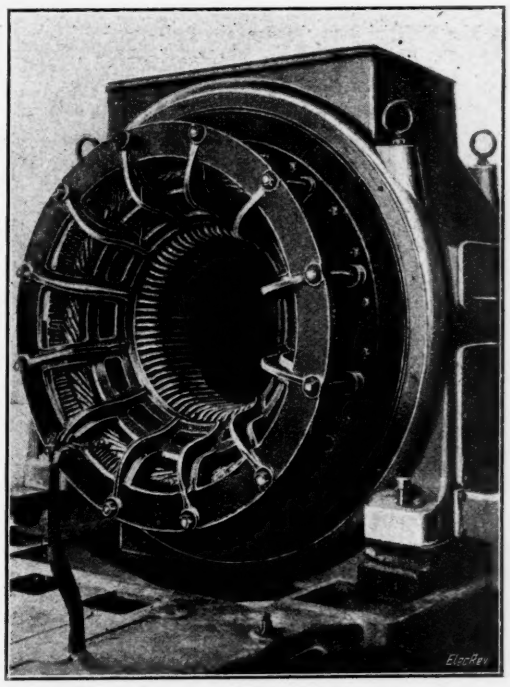
Charging is performed by a motor generator, the pressure of supply from the Poplar Borough Council—460 volts—being too high to offer any advantages for the use of a reverse booster. The generator is differentially compounded, so that after current is switched on, further attention is unnecessary except in the case of a "gassing" charge.

We are indebted to the D.P. Battery Co. for the foregoing particulars.

THREE-PHASE PLANT AT SHIPLEY (YORKS.).

The first venture of the Shipley Council in public electricity supply was in 1900, when a small generating plant in connection with a Meldrum refuse destructor was brought into use. This plant was soon supplemented by two 240-KW. Parsons direct-current turbo-generators (in 1901), and considerable praise is due to the Council, and to its enterprising engineer at that time—the late Mr. Quinn—for pioneering a type of plant which has proved to be possibly the most important factor in modern electricity supply work.

Further developments followed, and by 1905 the Council's plant consisted of four boilers and four turbo-generators of a total capacity of 1,000 KW. In 1912 the Council, after inquiry, decided that the time had arrived to install a modern three-phase system to meet the industrial requirements of the area, and, having obtained borrowing powers for £30,000, proceeded to put down a three-phase 6,600-volt 50-cycle alternating-current system with rotary converters for traction supply and direct-current lighting and power, thus falling into line with the majority of progressive industrial towns.



Bracing of Stator End Windings, Shipley Alternators.

This new installation was officially inaugurated on February 2nd, the occasion being celebrated by a dinner at which many of those interested in local electricity supply work attended. The new plant includes two Babcock & Wilcox boilers fitted with integral superheaters and chain-grate stokers, with a rating of 20,000 lb. of steam at 160 lb. pressure, superheated to 550 deg. F.; two steam-driven Clarke-Chapman pumps have been provided for boiler feeding. Two Westinghouse-Rateau turbines, running at 3,000 R.P.M., each with a continuous output of 1,250 KW., have been installed; these are coupled to alternators by the Phœnix Dynamo Co., a special feature

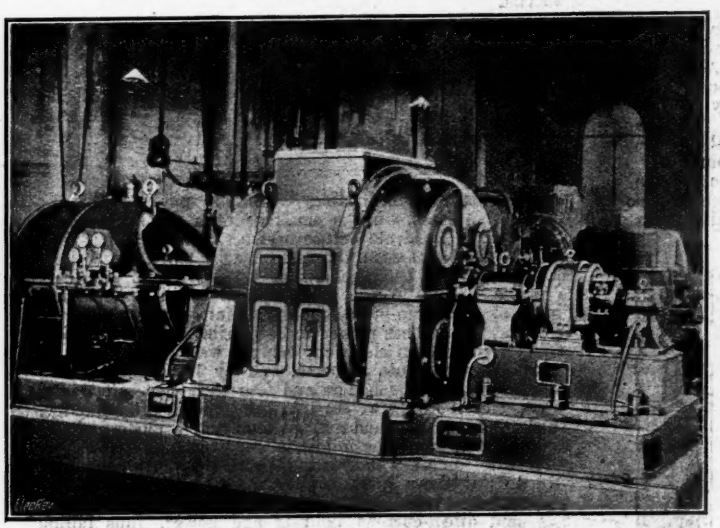
of the machines being the heavy steel clamping rings round the stator end windings and the ventilating arrangement, for which air is supplied from two Sturtevant dry-air filters equipped with motor-driven fans.

Each turbine exhausts into a Cole, Marchent & Morley surface condenser capable of dealing with 20,000 lb. of steam per hour.

The new three-phase switchgear was supplied and erected by the British Westinghouse Co., and is of the cubicle pattern designed to take care of future needs; supply is given to a large sub-station in the centre of the town, from which all distributing cables will run, the cable contract for some ten miles of three-core lead-covered cable drawn into ducts having been placed with the Western Electric Co., who have, we gather, supplied the bulk of the cable in use in Shipley.

Two rotary converters have been installed, one of 500 kw. capacity and Westinghouse make, and one of 300 kw. by the General Electric Co., for general direct-current supply purposes. The electricity works are situated on the Dockfield estate, which, together with two adjoining estates, amounting in all to 50 acres, were acquired by the Council and are now being disposed of for industrial purposes. During 1914-15 1,735,000 units were sold, and for the year nearly completed it is expected that 2,500,000 units will be sold.

We understand from Mr. W. Redmond, the Council's electrical engineer, to whom we are indebted for these particulars and under whose supervision these extensions have been carried out, that the new plant is giving every satisfaction, and that the coal consumption has been reduced by 50 per cent.; moreover, some of the local factories have already been connected to the new system, and others are in prospect.



Westinghouse-Phœnix Turbo-alternator at Shipley.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

The Lighting of Drawing Offices.

For the lighting of drawing offices, the British Thomson-Houston Co., of Mazda House, Upper Thames Street, E.C., usually advise the use of Mazda half-watt type lamps in their "Lumina" semi-indirect lighting fittings. A number of drawing offices have been equipped in accordance with this recommendation, and in every case great satisfaction has been expressed by the draughtsmen.

This system of lighting is used by a certain engineering and shipping firm in the Newcastle area, whose reputation is known all over the world—the engineer of which has stated that he had great difficulty in preventing the draughtsmen using the new lighting during the day time—they declared it better than the natural daylight. We illustrate the pendant and the close ceiling patterns of the "Lumina" fittings in figs. 1 and 2.

Fig. 1.—Pendant Type.

Fig. 2.—Close Ceiling Type.

B.T.H. "Lumina" Semi-indirect Lighting Fitting.

Anti-aircraft Lamp Screen.

We have received from Mr. J. W. Beauchamp, manager of the West Ham electricity undertaking, particulars of a new type of lamp screen, for which a patent has been applied for, and which has been designed as an inexpensive method of cutting off upward rays from lamps and avoiding the bright patch of light which usually results from the use of a conical reflector on an incandescent lamp. We understand that in practice it gives a very fair distribution of light.

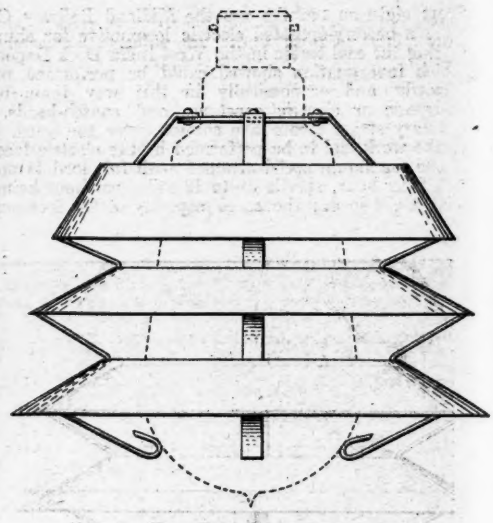


Fig. 3.—New Type Lamp Screen.

Figs. 3 and 4 show the construction and application of the screen which is made of sheet tin, and is being placed on the market by Messrs. Falk, Stadelmann & Co., of Farringdon Road, E.C.

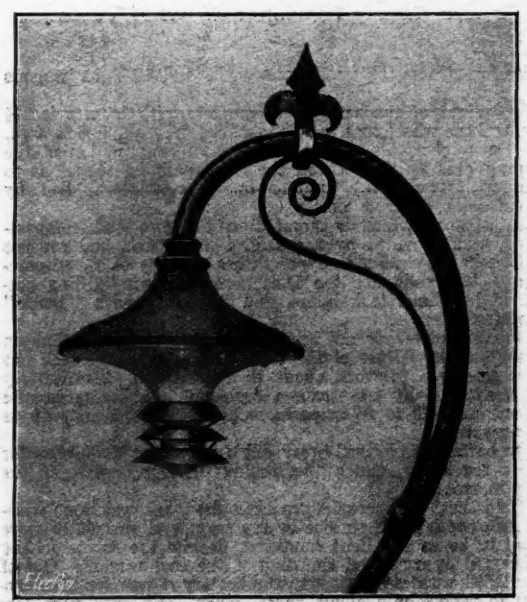


Fig. 4.—New Lamp Screen in use.

The reduced brilliancy required by the authorities can be most effectively obtained by using lamps of smaller candle-power or under-running or frosting; the practice of covering the lamp with an opaque coating is ineffective owing to the difficulty of maintaining it, and because by increasing the temperature, it shortens the life of the lamp. It is, in fact, obvious that the methods at present adopted for securing reduced illumination of our streets are crude and wasteful.

THE FUTURE ORGANISATION OF ELECTRICITY SUPPLY.

[COMMUNICATED.]

Considerable interest is attached to the circular issued a short time ago by the South Metropolitan Gas Co., inviting subscriptions to the company's stock by their consumers, in amounts of £5 and multiples thereof, at the price of £82 per £100 of stock. This investment, with gas at its present figure of 2s. 10d. per 1,000 ft., yields £5 7s. 3d. per cent., which is undoubtedly attractive; indeed, one is tempted to wonder at the Treasury giving their sanction to what must be a competitor to the War Loans. However, the scheme is distinctly interesting, and worthy of some consideration. The war will end sooner or later, and a difficulty will probably be found in raising capital for the many extensions and enterprises which have, perforce, been held in abeyance.

The issue of "Baby Bonds," as they are termed in America, has long been in operation in that country. The advantages of spreading a considerable portion of their stock amongst their consumers and employés have been realised by the companies, and used as a bulwark against the municipalisation of their properties and the undermining of their consumers by the gas opposition. The plan of giving consumers a direct holding and interest in their electric supply company has undeniably done much to restrain municipalities from undertaking work in this direction. One cannot help being forced to the conclusion that up to the present such enterprise has been against the development of the electrical industry in its broadest possibilities.

With the first boom of electric lighting, numerous provisional orders were granted in this country to small towns and districts; some of these were not even taken advantage of, but were merely obtained to block private enterprise. Nevertheless, at that stage a great impulse was given to electrical progress, but the cream of the possible lighting load having been obtained, most of these small municipal concerns have found themselves handicapped by the difficulty of obtaining powers for the hire of motors and apparatus. The fullness of time has shown that the effect of these small undertakings, with their cast-iron boundaries and restricted powers, has been to put the brake on still greater expansion by means of companies or authorities generating on a grand scale with the efficiency of big units and the advantages conferred by large diversity factors. Many of these concerns may be said to be in a state of polarisation, affording little or no profit to their owners and scant opportunity to those requiring cheap light and power.

The present chaotic condition of London's electric service is an example of this. We have numerous comparatively small areas supplied by municipal undertakings which are working under the disadvantages referred to, and companies who are deterred by the shortness of their tenure from exerting their full powers. So far, the various schemes put forward for solving the question of a comprehensive and cheap supply for this city have been abortive.

Much the same state of affairs obtained in the early development in America, except that in their case most of the towns and districts were catered for by companies. Therefore, as the advantages of amalgamation have been realised, it has been possible to assemble small operating companies into large holding companies. An American contemporary classified the advantages to be obtained into several divisions; briefly, they were:—

Efficiency.—Operating efficiency is greatly increased because the directing officers of large holding companies are the ablest men in the business, who contribute expert knowledge, superior administrative ability, and sound judgment. Those superintending actual operations possess abilities which command larger salaries than are obtainable in the smaller companies, and the benefits of their supervision are distributed among a large number of properties at a comparatively small expense. Holding companies have on their staffs expert engineers. Such engineering service is impracticable in small concerns. Alert, legal supervision is maintained, which is frequently of great importance but usually too expensive for a small company. Departmental operating costs are closely kept, carefully analysed and compared. Publishing and advertising can be co-ordinated and directed into the most profitable channels.

Economy.—In addition to the economies resulting from efficient operation, there are economies in the purchase of material by bulking the orders. The holding companies are always in touch with the markets, and are able to take advantage of cheap prices in any commodity or article, and to buy in advance of rising prices.

Holding companies, by the creation of large issues of securities based upon securities of subsidiary companies, give to this class of security a broad market. They distribute the risk among a large number of properties in different parts of the country, so that any adverse circumstance affecting one property does not materially injure the integrity of the security as a whole.

To sum up, it is claimed that the advantages rendered to the community are better service, cheaper service, broader service in populous centres, and service extension to village and rural communities.

The selling of "Baby Bonds" to consumers, which is a part of the policy of holding companies, has been reduced to a fine art, and almost every conceivable talking point is tabulated. Many of the arguments advanced are ingenious, but not of a nature to appeal to a British investor, who appears to prefer a certain stateliness in the dressing of a financial statement for his consumption. The issue of stock in small units, enabling small consumers to invest, and so acquire a real interest in the industry, has several very obvious advantages. It turns each holder into a friend, who will do his best to forward the development of the company amongst his acquaintances. This is an active influence, and is likely to do more good than the reliance on public spirit and civic pride, which it was hoped would do so much to foster municipal undertakings.

The popularity in America of the "Baby Bond," and of similar issues made in this country, invites the consideration of the extension of the principle to such a public service utility as electricity supply. In fact, it is nibbled at when deposits bearing interest are enforced, but as such they are usually a source of annoyance, operating against the supply authorities' welfare.

The present state of affairs is that with the idea of public control, huge monsters such as the Port of London Authority and the Water Board have been created. Most of these are financed with moneys borrowed upon public credit, and one could fairly safely say against the wishes of half the ratepayers concerned, who, however, seldom obtain the control that they are supposed to exercise, by reason of the multitude of questions generally involved at election times. This remark is not made as an attack on these services or with a view to belittling their work, but merely to emphasise the small amount of public control actually existing.

Assume that instead of forming such trusts on public credit, they took the form of companies with the controlling capital issued in small bonds. The board of directors would contain certain representatives of the municipalities whose districts were affected, much on the lines of the last L.C.C. scheme, who would be charged with the duty of seeing that the interests and rights of the community were protected. The affairs of the company would come up for revision at the usual general meetings, and where a vote was required it could be taken upon the direct issue with no consideration of politics supervening. One ventures to think that a more businesslike administration and better management would result.

No doubt the question bristles with difficulties, but it should not be impossible to discover some method which would open the way for a cheaper and more general supply of electricity. Some discussion of the subject may forward the question to a stage where it will be ripe for practical steps when the passing of the war leaves us free to act again. It may be that the application of the principle of the "Baby Bond" can be made in a way that would help to smooth the path for the large composite bodies that appear to afford a solution of the present state of deadlock. It will also be borne in mind that money is

changing hands, and there will be many small people with money to invest who will only be attracted by a class of investment which is sound. One with the possibilities and assured future of electricity supply should be well in favour if we work to deserve it.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Cause of Flicker.

I have under my charge three Belliss-Crompton D.C. generating sets, rated at 50 and 100 KW. at 450-550 volts, operating a three-wire overhead network, with Crompton's C.M.B. balancers. Only one machine is at present working at once, and the load is metal-filament lamps and fans.

We are experiencing trouble with a flicker in the lights, which seems to synchronise with the engine beat, and we are unable to find any cause for it. It does not always occur, but is sometimes scarcely noticeable, and at other times it becomes objectionable. All machines seem to be affected, but not to the same extent, the small set being the worst, and one of the 100-KW. sets. The third set very occasionally gives trouble, and then only slightly, and we have found that changing over to this set will stop the trouble. The flicker seems to start at half load on the first two machines, when the bus-bar voltage is about 485-490. The machines have only been in use two years, but this flicker was noticed from the beginning.

I should greatly appreciate any information or advice that your readers can offer as to the cause and remedy of this trouble.

F. C. Bulsara.

Nagpur, India, *January 29th*, 1916.

German Interest in Swiss Concerns.

In your valued paper issued January 28th, under the heading of "War Items," you have printed an article dealing with the German capital invested in Swiss concerns, in which you state that the Swiss journal, *Elektro-Industrie*, the paper of the Association of Electrical Contractors in this country, has expressed its sympathies for the Central Powers. This statement is apt to be misunderstood by the majority of your readers, who will wrongly be led to believe that the Swiss electrical contractors are to a large extent sympathising with the enemies of Great Britain. We feel it our bounden duty to challenge this view. Even if a few members of the Swiss Association of Electrical Contractors should in consequence of personal relations and, last, but not least, through lack of understanding of other people and nations and ignorance of conditions existing abroad, sympathise with the German cause, the majority of us have long ago realised that a too powerful commercial supremacy of one group of the Powers will endanger our economical and political independence. Our trade had suffered a great deal from disloyal German competition long before the outbreak of the war. The article in the *Elektro-Industrie*, written in favour of the German electrical trade, proves that in Switzerland both opponents in a dispute get a hearing, but it does not follow that it expresses the views of *all* its readers.

In conclusion, we should like to explain that the "blockade" policy practised in England and France against neutral Switzerland is hitting our trade badly, and we are wondering whether it will dawn on the Allies some day that their action in binding industrial forces over here that might be useful to them tends to strengthen the position of the German industry in Switzerland. It must be noted that the Germans are already organising themselves in order to win back the Swiss market after the war, if possible to a still larger extent than in pre-war times, and it looks as if they will succeed unless the Entente Powers discard their over-anxious policy of mistrust against Switzerland.

Théodore Schwarz.

Basle, Switzerland, *February 15th*, 1916.

City Guilds' Subject: "Electric Wiremen's Work."

"Electric Wiremen's Work" concerns not only wiremen, but also a much greater number of people who are intimately concerned with and interested in what might otherwise be termed "Everyday Electrical Applications." These other people are contractors, foremen, architects, charge electricians, inspectors, builders, clerks of works, students who will one day take up one of these callings, other students, and many others.

The subject (to quote another writer) deals (or should deal) first, with the elementary electrical principles involved; secondly, with the hundred and one kinds of consuming devices and accessories that are to (or should) be found in ordinary electrical installations (houses, shops, offices, small workshops, &c.); thirdly, with the simple theory of their construction and working; and, lastly, with the various methods of "wiring them up."

The above shows the fundamental importance of the subject, and the City Guilds' report for last session proves how grossly it is neglected by those in authority in some of our technical colleges, institutes, and polytechnics.

On page 20 of the Report we find that "Electrical Engineering" was taught at 117 centres last session, and "Electric Wiremen's Work" at only 57. Turning to page 22, we find, further, that there were 1,341 candidates for examination in "Electrical Engineering," and only 253 in "Electric Wiremen's Work." The 1,341 above does not, by the way, include those taking telephony, telegraphy, and electro-metallurgy. These figures indicate a very topsy-turvy condition of things, and prove that fundamental training in applied electrical work is to a great extent ignored by those whose duty it is to foster it.

For every student who is investigating the mysteries of dynamo design, alternating-current work, transmission systems, electrical instrument making, &c., &c., there should surely be a dozen or so who only desire a working acquaintance with everyday electrical matters.

It would be absurd, of course, to depreciate the value of the subjects included under "Electrical Engineering" in the City Guilds syllabus. But it seems quite evident from the above-quoted figures that we are paying too much attention to what might be termed exclusive subjects, and neglecting another subject which, if properly handled, should be spreading everyday electrical knowledge amongst thousands of people yearly. This would be to the ultimate benefit of the whole electrical profession and industry.

It is a fact, we believe, that in many institutes the students, though they have practical tuition in jointing, &c., are not treated to lectures based on the "E.W.W." syllabus, but have to attend the elementary electrical engineering classes. This, obviously, is very unsatisfactory.

Had things not been as they are, we should not, perhaps, have had *The Wireless World* saying in its February issue (p. 734) that the City Guilds Institute was "not really very well known"! A rather remarkable statement, considering it has been carrying on its work for about 35 years.

A. P. Lundberg & Sons.

London, N., *February 21st*, 1916.

WAR ITEMS.

Enemy Companies.—The "Times" states that the committee appointed to advise the Board of Trade in tackling companies of enemy nationality or association held its first meeting on February 17th. The affairs of four companies were gone into, but as the proceedings were private no decision was announced.

In the House of Commons, on Monday, in reply to a question, Mr. Pretyman stated that the committee had numerous cases before them. The list of persons, firms, or companies whose businesses might be ordered to be discontinued wholly or partially or wound up would be laid before both Houses from time to time, and notices of such orders would be gazetted. There would be no unnecessary delay, but it was desirable to pass all the names through the committee. It was difficult to draw the line as to exactly whether a firm should come before the committee or should not. In reply to another question, Lord R. Cecil said that the black list under the Act was in an advanced state of preparation, and publication would be commenced shortly.

Westinghouse War Relief Fund.—We have before us a copy of the balance sheet down to December, 1915, of the British Westinghouse Employés' War Relief Fund. A meeting of the delegates was called for yesterday evening at the British Westinghouse Club, Moss Road, Manchester, when Mr. J. H. Tearle was to preside. During the period from August, 1914, to December, 1915, the contributions by employés amounted to £13,648, and that contributed by the company was £6,291; adding a small sum for donations and bank interest received, the income was £20,038. The payments to dependents were £12,047. Christmas gifts stand at £885. Donations were sent to local hospital, Red Cross, and other funds to the tune of £500, and national donations were £680. There has been transferred to the Widows' and Orphans' Fund £4,000, and a balance of £2,312 remains at the bank. The Widows' and Orphans' Fund is almost entirely invested in Treasury Bills.

Tramcar Lighting Prosecution.—At Blackpool, on February 18th, Arthur Bolton, tramcar conductor, was summoned for failing to obscure the car lights. Three other conductors were summoned for similar offences. The car in question was seen standing in Talbot Square with 13 lights switched on, and they were visible seawards. No blinds were drawn. The Chief Constable said he had brought these matters to the notice of the tramway people time after time. Some of the complaints had been attended to, and some had not. A fine of 20s. was imposed in each case.

Trading with the Enemy.—The Board of Trade has appointed Sir Edwin Cornwall, M.P., to be a member of the Advisory Committee in connection with the Trading with the Enemy Amendment Act, in place of Sir George Croydon Marks, M.P., who, owing to work under the Ministry of Munitions, cannot serve. Sir George is at present acting as Special Commissioner in the Tyne district to deal with the inauguration of schemes for the dilution of labour.

Use of Electric Torches.—The use of electric torches in Essex has become so great that the Chief Constable has issued a notice to all superintendents in the county that in future proceedings will be taken against any person displaying any light in such a manner as to serve as a signal. Unless the nuisance is abated, an order will be made by the competent military authority prohibiting the use of electric torches in the open.—"Times."

IMPORTS OF HOLLAND.

The following figures, showing the imports of electrical and similar goods, for consumption, into Holland during the year 1914, are taken from the recently-issued official trade statistics; the figures for 1913 are added for purposes of comparison, and notes of any increases or decreases are given:—

	1913. Gulden.	1914. Gulden.	Inc. or dec. Gulden.
Machinery, steam, industrial and agricultural.—			
From Belgium	3,690,000	2,513,000	– 1,177,000
,, Great Britain ...	11,062,000	6,481,000	– 4,581,000
,, Hamburg	236,000	191,000	– 45,000
,, Germany	29,036,000	23,867,000	– 5,169,000
,, United States ...	4,758,000	2,678,000	– 2,080,000
,, Other countries ...	798,000	515,000*	– 283,000
Total	49,580,000	36,245,000	– 13,335,000
* Sweden, 338,000 Gulden.			
Gutta-percha, raw.—			
From France	333,000	31,000	– 302,000
,, Great Britain ...	174,000	549,000	+ 375,000
,, Dutch Guiana ...	1,959,000	744,000	– 1,215,000
,, Java, &c.	1,650,000	709,000	– 941,000
,, Other countries ...	237,000	113,000	– 124,000
Total	4,353,000	2,146,000	– 2,207,000
Gutta-percha manufactures.—			
From Belgium	578,000	503,000	– 75,000
,, Great Britain ...	156,000	176,000	+ 20,000
,, Germany	402,000	221,000	– 181,000
,, Other countries ...	1,000	1,000	—
Total	1,137,000	901,000	– 236,000
Iron wire.—			
From Belgium	3,785,000	4,143,000	+ 358,000
,, Great Britain ...	21,000	32,000	+ 11,000
,, Germany	86,486,000	18,577,000	– 67,909,000
,, Sweden	546,000	347,000	– 199,000
,, Other countries ...	23,000	42,000	+ 19,000
Total	90,861,000	23,141,000	– 67,720,000
Instruments, physical, chemical, &c.—			
From Belgium	810,000	384,000	– 426,000
,, Great Britain ...	547,000	538,000	– 9,000
,, Hamburg	401,000	439,000	+ 38,000
,, Germany	7,639,000	6,246,000	– 1,393,000
,, Other countries ...	149,000	271,000	+ 122,000
Total	9,546,000	7,878,000	– 1,668,000
Copper wire.—			
From Belgium	211,000	90,000	– 121,000
,, Great Britain ...	152,000	392,000	+ 240,000
,, Hamburg	6,000	306,000	+ 300,000
,, Germany	4,038,000	2,643,000	– 1,395,000
,, Other countries ...	80,000	78,000	– 2,000
Total	4,487,000	3,509,000	– 978,000
India-rubber manufactures.—			
From Belgium	2,343,000	2,417,000	+ 74,000
,, Great Britain ...	8,548,000	2,271,000	– 6,277,000
,, Java	2,917,000	8,520,000	+ 5,603,000
,, Germany	115,000	106,000	– 9,000
,, Russia	1,273,000	*	*
,, United States ...	91,000	12,000	– 79,000
,, Other countries ...	791,000	912,000	+ 121,000
Total	16,078,000	14,238,000	– 1,840,000
* Not shown separately.			
Steel wire.—			
From Belgium	866,000	581,000	– 285,000
,, Great Britain ...	909,000	571,000	– 338,000
,, Germany	5,283,000	2,124,000	– 3,159,000
,, Other countries ...	118,000	70,000	– 48,000
Total	7,176,000	3,346,000	– 3,830,000
Glass manufactures.—			
From Belgium	330,000	195,000	– 135,000
,, Great Britain ...	141,000	114,000	– 27,000
,, Germany	2,303,000	2,206,000	– 97,000
,, Other countries ...	18,000	13,000	– 5,000
Total	2,792,000	2,528,000	– 264,000
Porcelain.—			
From Belgium	224,000	129,000	– 95,000
,, Great Britain ...	94,000	44,000	– 50,000
,, Germany	1,577,000	1,400,000	– 177,000
,, Other countries ...	112,000	107,000	– 5,000
Total	2,007,000	1,680,000	– 327,000

Note.—Gulden = 1s. 8d.

REVIEWS.

Dielectric Phenomena in High-Voltage Engineering. By F. W. Peek, Jun. London: Hill Publishing Co., Ltd. Price 12s. 6d. net.

The author sets out in this book the properties of gaseous, liquid, and solid insulators, and the methods of utilising these properties to the best advantage in the problems of high-voltage engineering. Methods that have proved useful in designing apparatus, transmission lines, insulators, bushings, &c., are discussed and illustrated by practical examples. In addition, such subjects as the manner of making extensive engineering investigations and of reducing data, the measurement of high voltages, the effects of impulse and high-frequency voltages, methods of drawing dielectric fields, outline of modern theory, various dielectric phenomena, &c., are considered.

A great deal of original work is described (and this is what makes the book so valuable), and there is ample reference to other investigations. It is interesting to note that the author's extensive research was made possible by facilities afforded by the Consulting Engineering Department of the General Electric Co. His work has to do chiefly with the "visual" corona, which may be defined as follows:—If potential is applied between the smooth conductors of a transmission line and gradually increased, a voltage is finally reached at which a hissing noise is heard, and if it is dark, a pale violet light can be seen to surround the conductors. This voltage is the critical visual corona point. If a wattmeter is inserted in the line, a loss is noticed. When alternating voltage higher than the critical voltage is applied between two parallel polished wires, the glow is quite even, but after operation for a short time reddish beads or tufts form along the wire, while round the surface of the wire there is a bluish-white glow. If the conductors are examined through a stroboscope, so that one wire is always seen when at the positive half of the wave, it is noticed that the reddish tufts or beads are formed when the conductor is negative and the smoother bluish-white glow when the conductor is positive. The author gives particulars of different sets of experiments in the study of corona, amongst others the effect of spacing and size of conductor, the effect of temperature (the experiments varied over a range of – 20 deg. C. to 140 deg. C.), effect of oil, water, or dirt on the visual point. Tests made over a very wide humidity range show that humidity has no appreciable effect upon the starting point of visual corona, but after corona is present, humidity has an effect on the spark-over voltage. Change of initial ionisation of the air, even to a considerable extent, has no appreciable effect on the starting point of corona. A test was made to see if heavy current flowing in the wire would change the starting point, but it was found that such current does not appreciably affect it unless the temperature of the wire is increased.

Specially interesting is the author's photographic study of corona on wires and cables. The method adopted was as follows:—Two parallel conductors were spaced 122 cm. between centres. The camera was focused on one conductor only. The distance to the lens was such as to show the conductors at approximately actual size. An exposure was made for a given time at a given voltage. The plate was then shifted slightly, the voltage increased, and a second exposure was made for the same time. Thus a given series shows the same part of the same single wire at different voltages.

Two photographs are given showing the effect of moisture. A stranded cable was brought up to the critical point, and water was then thrown on it. What was a glow at the surface of the dry cable became, at the wet spots, a discharge extending from 5 to 8 cm. from the conductor surface. Other

photographs show the corona on bright tinned phosphor-bronze wire, on copper wire polished after each exposure, on weathered galvanised iron wire, on a polished brass rod, and unpolished copper cable, and so on.

The author is to be congratulated on the quantity and quality of the original work he has done. The account of his extensive experiments on high-voltage electricity is exceedingly interesting, and his descriptions of apparatus are always clear and his photographs excellent.

Rubber Machinery. By Henry C. Pearson. New York: 1915. *The India-Rubber World* Press. Price 6$ in U.S.A., post free.

Mr. Henry C. Pearson is the editor of the *India-Rubber World*, the chief organ of the rubber trade in the U.S. But besides being a most successful and brilliant technical journalist, he is, and has always been, a practical rubber man, keenly alive to every phase, past, present, and future of the rubber industry. As a result, he has in the past produced works, such as "Crude Rubber and Compounding Ingredients," which are to be found in the reference library of every self-respecting rubber manufacturer. His latest effort, *Rubber Machinery*, is perhaps the most useful of the series, for while—as the author points out in the preface—"mechanical and inventive ingenuity has been producing machinery for use in rubber manufacture" for fifty years, this volume is, so far as we are aware, the first published work, at any rate in the English language, dealing comprehensively with rubber machinery. There have been many rubber books in which typical machines have been features in illustrations of processes, but none in which the processes have been referred to merely to explain the machines. Technical works dealing with machinery are frequently no more than a series of illustrations from manufacturers' catalogues strung together on a thin chain of uncritical letterpress. Such works serve, perhaps, to remind us of much that we had forgotten, but they are scarcely stimulative of thought. Mr. Pearson's volume does not belong to this class; he writes with discrimination as well as with skill. His object, he states, is . . . "to record the machines that are of general application either to all or to a number of the lines into which the trade is divided . . ." To this end, he tells us, "voluminous matter has been collected from machinery makers the world over; from rubber factories, from patent specifications—American, English, German, and French. The actual value of such a collection to the rubber manufacturer, whatever his line, should be great, but the *suggestive value* (the italics are ours) will be even greater." In our view, Mr. Pearson has very largely achieved his object, but his success in this regard is not due entirely to "collecting voluminous matter" from various sources; without the author's practical knowledge of the industry and the exercise of his critical faculty it might have been a poor thing. As it is, however, the volume should find its way to the shelves of all those whose work brings them into contact with rubber machinery. The book is sub-divided into twenty chapters; of these, the first two are devoted to machinery used in washing and drying crude rubber; Chapters III and IV deal with the handling of mixing materials and the process of mixing; Chapters V and VI with calenders and plant for preparing fabrics for calendering and spreading; Chapter VII with clutches, drives, and safety stops for mills and calenders; Chapters VIII to X with vulcanising plant, materials, and methods. Chapter XI is a useful contribution on the subject of tube-making machinery, while the two succeeding chapters are devoted to spreading, doubling, and finishing plant. Chapter XIV, on cement and solution machinery, is the last on what may be termed rubber manufacture proper. After a couple of chapters on the extraction of rubber and gutta from shrubs, vines, &c., and of resins from low-grade rubbers, we have (Chapters XVII and XVIII) a very interesting section dealing with reclaiming. Chapter XIX, on temperature recording and controlling devices, will be of more than passing interest to those (and they are many) who have endured losses and worry as the result of over or under-vulcanising. The concluding chapter is on rubber laboratory equipment, and in this, we think, will be found much that is suggestive even to those whose work lies wholly in the laboratory. Here and there we meet with views or statements that are capable of criticism; for instance, the authors' estimate of the capacity of certain types of crude rubber washing plant appears to us to be rather high; again, the views expressed on the subject of the "nerve" of crude rubber and methods of determining it will scarcely meet general acceptance. They appear to be based on some recent publications of Caspari's, which will, however, require a great deal of confirmatory work before the somewhat sweeping deductions made from them can find practical application. These and other minor blemishes do not, however, affect the character of the book as a whole, nor need they interfere with our congratulations to Mr. Pearson for having given us a most valuable and interesting work.

British Trade Interests in Denmark.—An Exchange dispatch to the *Times* states that a special British Commercial Adviser has joined the British Legation at Copenhagen.

LEGAL.

Motor-car *v.* Tramcar.

Stipendiary Neilson has issued judgment in the Glasgow Police Court in the prosecution of a Glasgow T.C. motorman who was charged with recklessly driving the tramway car under his charge, and causing it to collide with a motor-car and damage the vehicle and injure its occupants. The impact was so great that the tram-car was forced off the rails. Dealing with several authorities which had been submitted to him, the Stipendiary said the principle laid down in Macandrew & Tillard (1909) clearly applied to the present case, so as to primarily lay the responsibility of avoiding the collision upon the vehicle which was emerging from a small side street upon an important public thoroughfare on which there were tramway rails along which, according to the Board of Trade regulations, it was lawful for a tramway car to travel at a rate of sixteen miles per hour. A motor-car was a much more mobile vehicle than a tramway car, and therefore the chief responsibility for the avoidance of danger lay upon the motor-driver. He found the charge against the motor man not proved.

Munitions Court Cases.

At the Manchester Munitions Court on Saturday, a firm of electrical engineers summoned Messrs. Humphrey Lloyd & Sons, for engaging a youth named Carnall and taking him away from a controlled establishment. The case was brought under Sec. 12 of the Amended Munitions Act, and it was stated for plaintiffs that they had warned defendants that they were infringing the Section by employing Carnall. Defendants' statement was that Carnall replied to their advertisement for a clerk, and he was engaged subject to his references being satisfactory. Plaintiffs subsequently informed them that theirs was a controlled establishment and that they could not spare Carnall, whereupon Humphrey Lloyd & Sons informed the youth by letter that they could not continue the engagement. On the following day, February 8th, Mrs. Carnall called and the youth also wrote, and both stated that he was not employed on munitions, that he had no badge, and that he would not return to his old place. Defendants, added the statements, were not a munition firm, and as the statements seemed satisfactory, the defendants kept the youth at work. The defendant firm were fined £3 and the youth £1, the latter not to be enforced if he returned to his work by the following Wednesday.

An electrical fitter employed by the Admiralty at Sheerness, last week applied for his discharge, on the ground that, as overtime had been abolished, his wages were insufficient to keep himself and his home going at Ashton-under-Lyne. He desired (according to the *Standard*) to get work at Manchester. There were six fitters, two labourers, and an assistant doing the job which one man did before the war. A representative of the Admiralty said that no overtime was promised, but the man worked overtime from February, 1915, to January last, his average earnings being £4 6s. 3d. a week. There was a difficulty in getting electrical fitters, and the Admiralty had to keep up a large staff to deal with any emergency that might arise. The certificate was refused.

Grocott *v.* Lovatt & Booth.

At Staffordshire Assizes last week, before Mr. Justice Avory and a jury, Richard Thomas Grocott, trading as Gaskell & Grocott, manufacturers of electrical earthenware fittings, of Longport, near Burslem, brought an action against Joseph Lovatt, general secretary, and Jabez Booth, organiser, of the National Amalgamated Society of Male and Female Pottery Workers, to recover damages for libel.

According to a report in the *Manchester Guardian*, Mr. Graham, for the plaintiff, said that he claimed damages for a libel contained in a handbill issued on May 25th last. In that month there was considerable agitation not only in the pottery trade, but in most other trades all over the country, for an advance in wages on account of the increased cost of living. This was shared by the workpeople at Longport, and on May 7th Mr. Lovatt, general secretary of the Union, wrote to the plaintiff's firm stating he was instructed by the operatives to ask for an advance of 10 per cent. in wages to all day wage and piece workers on account of the increased cost of commodities. This appeared to be an entirely gratuitous interference between Mr. Grocott and his workpeople, because the vast majority of them belonged to a special Union which looked after the interests of their particular branch of the trade. The plaintiff took no notice of the letter or of a similar letter written a little later, in which it was stated that the manufacturers had agreed to pay a bonus of 7½ per cent. Recognising the general demand for an increase of wages as being a just one, Mr. Grocott, in common with most other employers in the district, granted of his own accord a war bonus of 7½ per cent. to his employés, and paid it for the first time upon May 22nd for the week beginning May 15th. Three days later a handbill was distributed outside the works. It convened a meeting and stated that the business to be discussed was the 7½ per cent. war bonus, and added, "If you are anxious to secure the war bonus, attend this meeting. You can only obtain it by joining this society. Now is the time to join." The plaintiff complained of this as being a libel upon him, because it implied that he was not at the time paying the war bonus as other employers were doing.

Mr. Milward, for the defendants, asked the jury to say that

there was no libel and no intention to libel the plaintiff. He pleaded that his clients had no knowledge of the handbill.

The Judge said the jury knew how dangerous it was in these days when the relations between employers and employed were delicate to ruffle or disturb relations between masters and men which were amicable. In this case there appeared to be no ground for the imputation alleged, because the plaintiff was already paying the war bonus when the handbill was issued, and this fact could easily have been ascertained from any of the plaintiff's workpeople.

The jury returned a verdict for the plaintiff, and assessed the damages at £200.

The Lighting of Kingstown.

The Court of Appeal, Dublin, was, last week, engaged considering an appeal brought by the Dublin Southern District Electric Supply Co., Ltd., from a decision of Mr. Justice Barton, refusing an application for an order directing the Taxing Master to tax the costs of the company against the U.D.C. of Kingstown, on the scale provided for by the Acts for the taxation of Parliamentary costs, or, in the alternative, directing that the costs should be taxed as Chancery costs on the higher scale, as between solicitor and client, or for such other order as the Court might deem reasonable. The case related to the arbitration proceedings between the Kingstown U.D.C. and the Dublin Southern District Electric Supply Co., in connection with the Kingstown lighting scheme.

On Monday the Lord Chancellor said that the view of the Court was that the appeal should be dismissed with costs, but as some questions of general importance had been raised with which it would be necessary to deal, they would deliver a considered judgment as soon as possible.

Farrell *v.* Bloxam

Before Mr. Justice Gibson and Mr. Justice Pim in the King's Bench Division of the High Court of Ireland, application was made on defendant's behalf for an order changing the venue of trial from the City of Belfast to the City of Dublin in the case of Mr. A. B. Farrell against Mr. T. W. Bloxam. The action has already been referred to in our pages.

In the result the Court changed the venue to the County of Antrim, costs to be costs in the cause, Mr. Justice Gibson remarking that this would enable plaintiff to have justice and to have the action tried (at Assizes) as cheaply as possible.

THE SWISS MACHINERY INDUSTRY.

The importance of Switzerland as a producer of machinery and competitor in the markets of the world is clearly illustrated in the annual report which was recently published by the Swiss Association of Machinery Manufacturers (Verein Schweizerischer Maschinen Industrieller). Although the report does not contain any record of the total output of machinery of all kinds in that country, it quotes details of the import and export trade in 1913 and 1914, and mentions that the number of works belonging to the Association was 154 in 1914 as against 155 in the previous year, whilst the workmen and apprentices, of whom one apprentice to 10 workmen appears to be the rule, comprised 36,123 and 43,081 in the two years respectively. As will be seen from the accompanying table, the total imports of machinery declined from £2,298,000 in 1913 to £1,647,000 in 1914, the reduction being entirely due to fewer deliveries being received in the second half of the year:—

Total Value of Foreign Trade in Machinery.

	Imports.	Exports.
1913 ...	£2,298,000	£4,473,000
1914 ...	1,647,000	3,561,000

There is no reason for assuming that the native makers secured any substantially greater share in meeting home requirements as a result of the diminished imports in 1914, as the decrease was rather due to the general depression in the purchasing industries through the war.

As might be expected from its geographical proximity and great industrial development, Germany occupied the principal position in the Swiss import trade, the deliveries from the former to the latter having been £1,600,000 in 1913 and £1,112,000 in 1914, or 70 per cent. and 68 per cent. of the total Swiss imports in the two years respectively. On the other hand, the exports from Switzerland to Germany only receded from £720,000 to £680,000 in 1914. The exports to Austria-Hungary decreased from £196,000 in 1913 to £140,000, but the imports from the dual monarchy are only mentioned in the sense that Austro-Hungarian machinery participated in the total exports from Switzerland to the amount of 4 per cent. in both years. The imports from France fell by £80,000 in 1914, and the Swiss exports to France also diminished by £124,000. In the case of Italy the Swiss imports receded by £8,000 and the exports by £40,000.

The Swiss trade with Great Britain is set forth in the report separately for the first time. The imports are given as having been of the value of £113,000 in 1913, as contrasted with £69,000 in 1914, whereas the Swiss exports are returned at £217,000 and £210,000 in the two years respectively, a substantial advance having taken place in dynamos and milling machinery. The report emphasises the great loss of trade which occurred in the most important market for Swiss machinery, namely, Russia, where a decrease of £228,000, or 33 per cent., took place in 1914; a diminution of £200,000, or over 50 per cent., took place in the case of South America, and one of £108,000, or 37 per cent., in the trade with Spain, as compared with 1913. The table which next follows also records the foreign trade in electrical and certain other machinery in the years set forth:—

	Imports of electrical machinery.	Exports of electrical machinery.
1910 ...	£48,000	£626,000
1911 ...	40,000	721,000
1912 ...	59,000	689,000
1913 ...	61,000	814,000
1914 ...	55,000	623,000

Foreign Trade in Certain Other Machinery.

	Imports.		Exports.	
	1913.	1914.	1913.	1914.
Hydraulic turbines and pumps	£29,000	£18,000	£340,000	£260,000
Steam engines and steam turbines	34,000	19,000	419,000	236,000
Gas, oil and benzine engines	24,000	21,000	476,000	350,000

If the imports are deducted from the value of the exports, it wil be found that the latter represented an apparent surplus of £2,175,000 in 1913, and one of £1,914,000 in 1914. It must, however, be borne in mind that Switzerland is a large purchaser of foreign machinery for re-exportation as the report, although not specifically referring to re-exports, gives the share held by various countries in the total exports of machinery from Switzerland in the two years under consideration. If these shares are brought together for the principal countries, the following results in percentages of the values are shown:—

Participation of Foreign Machinery in the Total Exports from Switzerland.

	1913.	1914.
Germany...	16·3 per cent.	19·3 per cent.
Austria-Hungary ...	4·0 „	4·0 „
France	17·7 „	18·7 „
Italy	8·9 „	10·1 „
Great Britain	4·9 „	5·9 „
Total	51·8 „	58·0 „

The total sum represented by the above percentages of the exports in either year is greater than the total value of the imports either in 1913 or 1914, and the percentages can, therefore, not be regarded as thoroughly reliable. At the same time the figures lead to the assumption, which appears to be wholly justified, that the entire value of the imports of machinery is also contained in the total value of the exports for each year.

BUSINESS NOTES.

Inquiry from Canada.—A Montreal firm having branch stores in Quebec, Ottawa, Toronto, and Vancouver, and travellers throughout the Dominion, wishes to obtain agencies for British electric lamps, &c. Apply Board of Trade Commercial Intelligence Branch, London.

Trade Announcement.—Messrs. Napier, Kimber, Ltd., announce that Mr. R. N. Cunningham is not now connected with the company. He has disposed of the whole of his ordinary shares and resigned his directorship, and Mr. A. W. Kimber becomes principal shareholder and will remain managing director.

British Trade with Russia.—The Board of Trade Commercial Intelligence Branch has issued a special eight-page reprint relating to "Possibilities of British Trade with Russia." It is a memorandum prepared by the Acting British Consul-General at Moscow. We have not space to spare to deal with it at length at present, but we recommend it to the attention of all firms that are interested in our future trade relations with Russia. The writer emphasises the need for organised preparation; shows the necessity for a knowledge of local conditions; and makes a comparison between British and German methods. He discusses four suggested methods of developing British trade:—(1) Local representation; (2) the "Group" agency; (3) commercial banking; establishment of forwarding agents; (4) official visit of British merchants. In conclusion, the principles of successful trade are considered.

Science and Industry in Australia.—At a conference held at Melbourne, on January 5th, the Prime Minister, Mr. Hughes, presiding, it was resolved that an advisory council be established to formulate proposals for a national bureau of science and industry. The Prime Minister said that great industries, primary and secondary, must be stimulated, advised, and aided by scientific industrial research, and by wise laws. Provision would be required for a bureau of standards, and for industrial research; there should be a scheme so broad as to reach right down from the central institution to the preparatory schools, for there was only one way by which the scheme could be effectively carried out—and that was to reach the people when they were young, and to impregnate them with science. Mere money would not be allowed to stand in the way.

The British Industries Fair.—This Exhibition, which has been organised by the Board of Trade, will remain open until March 3rd. It is being held in the Victoria and Albert Museum, South Kensington, and in order not to interfere with the production of munitions of war, the exhibits have been limited to printing and stationery; china, earthenware and glass; fancy goods and toys. Over 100,000 invitations have been issued, but if there are wholesale buyers in any of these trades who have not yet received tickets they can obtain same by applying to the Board's Cheapside offices. Our own impression of the Fair, formed on Monday afternoon, when Her Majesty the Queen made a tour of inspection under the guidance of Mr. Runciman, is that an unqualified success may be expected. We confess to experiencing something in the nature of a shock when we found that the greater part of the ground floor of the Museum had been temporarily cleared of its serious permanent collection in order to make room for collections of dolls, teddy bears with sparkling electrical eyes which lit up by means of a switch at the centre of their frontal curvature, golliwogs, and all sorts of funniosities, but, after all, the Exhibition is a very serious affair, affording very acceptable indications of the efforts that British manufacturers are making in various departments of industry to dispense with German-made goods. Not many electrical articles come under the classification of trades adopted for this event, but those of our readers who visit the Museum should make a point of visiting the stands of the several enterprising firms who are engaged meeting the very large demand that exists for pocket and other portable electric lamps and articles that come within that category. From our conversation with those in charge of such exhibits, we gathered that the spirit of all engaged in this branch of the electrical industry was one of the most thorough-going optimism. What has been done since the outbreak of war, what is being done now, in spite of all the labour difficulties of the time, and what is in prospect for the days when military and munitions demands fall away, altogether make a most interesting story. Some there are who say that British manufacturers were beating German manufacturers in such lines before the first shot in this war was fired, but all are confident that we shall be so strongly prepared that there need be no fear of our losing the market after the war. The Efandem Co., of Wolverhampton, had an output of 3½ million batteries last year—this year it will be 5 million. Of actual pocket lamps they turned out an average of 35,000 per week from January to December last year, and everything was made at Wolverhampton. There may have been difficulties in regard to glass lenses, but even here English manufacturers are rising to the occasion. The Efandem Co. are also developing a number of new lines, such as bells and indicators and general novelties in which Germany was to the fore in many parts of the world, and the result is gratifying. On their stand will be found many devices which certainly cannot correctly be called "toys," for we noticed military equipments of electric lamps for fixing on the bridle and on the stirrup, also lamps for shell inspection and trench service, which show the adaptability of the firm for meeting the requirements of the Forces. The British Ever-Ready Co., Ltd., also have what for this exhibition is a comparatively large stand where an excellent range of pocket lamps, portable hand and reading lamps, torches, miners' lamps, dry cells, accumulators, and many electrical specialities is well displayed. This company has been doing a splendid business for some time past, and we learned with satisfaction of important works extensions for dry battery manufacture which are in hand, concerning which more later we hope. Messrs. Ward & Goldstone, as our readers have already been made aware, are also exhibitors of many of the lines for which they have long been so well known. Pocket lamps and batteries, hand lamps, portable lamps, model motors and dynamos, Ford starting batteries, electric cycle lamps, magneto-electric machines, "Volex" dry batteries and electrical novelties are shown in great variety. Messrs. F. Darton & Co. have on display many hand and pocket lamps, model motors and dynamos, model electric boat motors, accumulators and dry cells, car-lighting dynamos, water motors and dynamos for running from household taps, Samson dry cells, and many electrical machines and novelties. But they have developed also very largely their lines of meteorological and other instruments, and are doing well in that department. Messrs. W. A. & R. J. Jacobs, Ltd., the Surrey Electrical Co., Ltd., and Mr. T. Baxter also have interesting exhibits of pocket lamps. Here and there the electrical visitor will find other features of interest, and in the pottery and earthenware sections the enterprise of the British manufacturer is very evident.

Catalogues and Lists.—Messrs. Smart & Brown, Erith, Kent, have issued a wall calendar, showing in colour one of their motor launches as supplied to the Thames Police last year.

Muldivo Calculating Machine Co., 49, Queen Victoria Street, London, E.C.—Leaflet relating to the "Muldivo" calculating machine, which is of French manufacture.

Sun Electrical Co. Ltd., 118 120, Charing Cross Road, London, W.C.—Price list of "Britannia" metallic-filament drawn-wire lamps.

Jackson Electric Stove Co., Ltd., 38, Blandford Street, London, W.—Illustrated price cards relating to coffee percolators and hot-water urns.

The Schenectady Works.—Some of the London newspapers have published exaggerated reports respecting the recent fire at the General Electric Co.'s works at Schenectady. We learn on the best authority that the damage done is so slight as to be hardly worth mentioning, and that the work of production will not be in the least interfered with.

Bankruptcy Proceedings.—W. C. Wild, electrical engineer, Halifax.—First and final dividend of 5s. 7¼d. in the £, payable at Official Receiver's office, 12, Duke Street, Bradford.

G. E. Bonner, electrical engineer, Palmer's Green.—The public examination of this debtor was held at the Court House, Edmonton, on February 21st.

F. H. Watts, electrical engineer, 40, Mincing Lane, E.C.—Trustee released, December 6th, 1915.

A. J. Loader, "Medical Electrician," Nelson.—Trustee released, December 13th, 1915.

Liquidation.—Electro Steel Foundries, Ltd., Darlaston.—March 4th is the last day for the receipt of proofs for dividend, by Mr. H. E. Burgess, the liquidator, 33, Carey Street, W.C.

Inquiry from Brazil.—The Acting British Consul-General at Rio de Janeiro reports a local demand for steel poles for the suspension of arc lamps. Satisfactory supplies have hitherto been obtained from Germany. Supplies of electrical insulators have also been obtained from Germany in the past, and consumers state that they have only been able to secure inferior substitutes from the United Kingdom since the outbreak of war. Samples of insulators of German make have been received from the Consul by the Board of Trade Commercial Intelligence Branch in London, to which communications should be addressed.

Book Notices.—"Wireless Transmission of Photographs." By M. J. Martin. London: The Wireless Press. Price 2s. 6d. net.

"The Rubber Growers' Association, London, E.C. Annual Report of the Council for 1915."

"Thomas Alva Edison." By F. Rolt-Wheeler. London: Macmillan & Co., Ltd. Price 2s. net.

"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXV. No. 2. February, 1916. New York: The Institute. Price $1.

The Committee of Management of the San Francisco International Engineering Congress, 1915, announces that the volume on Mechanical Engineering is ready for distribution, and the members who have subscribed for this volume will soon receive it. The other volumes will be issued as rapidly as possible.

LIGHTING AND POWER NOTES.

Argentina.—A new electric power house was formally inaugurated at Acebal (Province of Santa Fé) last month. The establishment belongs to Senor Julio Hardy.

La Prensa's correspondent at Tucumán says that owing to the shortage of water, the Electrica del Norte Co. has addressed a note to the municipality, stating that it will be obliged to leave the city in darkness unless the water required for the power station be forthcoming. The Intendent replies that the municipality must adopt measures to guarantee the regularity of the public and private lighting service in terms of the contract. It is believed that this attitude will give rise to a serious conflict, as the municipality owes the company $300,000 m/n. for lighting. On the other hand, it appears that the company has sought the present pretext with a view to arriving at a settlement.—*Review of the River Plate.*

Atherton.—The electrical engineer has reported that the output is steadily increasing, and will soon reach the maximum load which the Tramway Co. is able to supply until such time as the new generating set is installed.

Bungay.—E.L. Scheme.—With reference to the E.L. scheme proposed by Mr. Best, of Bradford, the U.D.C. has deferred the question of entertaining the proposal until it is ascertained how similar schemes work in neighbouring towns.

Continental.—Spain.—The new central station at Segovia, belonging to the Sociedad Co-operativa Electra Segovians, has just been completed and put in operation. Water power is utilised, the plant comprising two Francis-type turbines supplied by Messrs. Escher, Wyss & Co., of Zurich, and two alternators by the Allmänna Svenska Aktiebolaget, of Stockholm.

Italy.—A report of the Demanio furnishes details of the natural water resources of Italy utilised for industrial purposes up to June 30th, 1914. The concessions granted number 3,161, for the production of 770,000 kw., without taking into account a large number of concerns working without legitimate title, and 2,600 grants under construction. The regions in which the concessions operate are 16 in number, the most important being Piedmont, which has 620 concessions, yielding 216,000 kw. Lombardy has 394 concessions, totalling 205,000 kw., and Umbria with 101 concessions, obtains 100,000 kw. In addition to the foregoing there were granted in the working year preceding June, 1914, 116 concessions for a total of 20 000 kw. The revenue obtained by the State Treasury from the taxation of concessions totalled on June 30th, 1914, 2,871,202 lire, which is exclusive of the income which should have been derived from a number of free concessions, granted under special Acts, representing a total of 33,500 kw.—*Rivista Tecnica d'Elettricità.*

Darlington.—Supply Developments.—At a recent meeting of the Electricity Committee it was reported that the supply of electricity for the 10 months of the year was up by 20 per cent. as compared with last year, and that for the last month there was an increase of 40 per cent. on the year, this, notwithstanding the reduced use of electricity for lighting purposes.

It was also reported that the contract with the N.E.R. Co. for the full supply of electricity for its works would date from June 1st next.

Dublin.—We briefly summarised last week the statements which were circulated locally regarding the contents of Mr. d'Alton's report on the Corporation electricity undertaking. From discussions which have since taken place in the Council chamber, we gather that all publication in the local papers, whether of the report or of the replies thereto, which have been made by certain officers of the department, is unauthorised officially and is premature. Doubtless Mr. d'Alton regards himself as being bound by those obligations of etiquette and confidence which for the present compel him to maintain silence. Probably when the proper time arrives, the Corporation Committee will officially publish the report and replies, and until then we prefer to withhold any comment that we may desire to make upon the matter.

In addition to the counter reports mentioned last week, Mr. Mangan, the city accountant, has now submitted a report more or less disagreeing with Mr. d'Alton's conclusions. Mr. Mangan apparently does not believe that the load conditions can be greatly improved in Dublin, and urges that in making price comparisons a distinction must be drawn between power and lighting supplies. He evidently agrees that some explanation is needed of recent coal costs and consumption, but points out that "units used on works" includes energy used at Fleet Street and other sub-stations, and therefore, subject to transmission losses. He further considers that his own analysis of salaries, &c., submitted to the town clerk last June, made this matter clear.

Asylum Lighting.—The returns of the cost of electric lighting at Richmond Asylum for 1915, as compared with gas lighting in 1911 show a saving of £978, and this although added buildings are now lighted.

Eccles.—There was a surplus of £632 on the Council's electricity undertaking for the year ended March 31st last. This has been carried to reserve.

High Wycombe.—Street Lighting.—The Electricity Co. has accepted the terms offered by the T.C. in respect of the public lighting up to the end of 1915, but objects to the proposals of the Council as to payment since January 10th, the date of the new lighting order issued by the Government. The company has asked that the matter shall be referred to arbitration, but the Council has deferred the question until the end of the current quarter.

Huddersfield.—Year's Working.—It was stated at a recent meeting of the T.C. that the electricity department had used 28,242 tons of coal in 1915, as compared with 20,781 tons in 1914, and that the cost had risen 75 per cent., indicating the possibility of a further increase in the price of electricity. The units sold totalled 10,536,374, an increase of 30·5 per cent., due to the demand for power; due to the night work, a considerably improved load factor resulted.

The borough treasurer's revenue statement for the year ended December 31st last, shows a balance of income over expenditure in respect of the electricity undertaking of £3,441; £1,291 is to be transferred to the depreciation and contingencies account, and the remainder carried forward.

Hull.—Smoke Nuisance.—The local Health Committee has threatened proceedings unless the smoke emitted from the chimneys at the Sculcoates electricity works is reduced. The acting electrical engineer, Mr. Magoris, has presented a report, pointing out the difficulty of complying with the request at the present time, and this is to be forwarded to the Health Committee. In effect Mr. Magoris points out that it is impossible to restrict capital expenditure, obtain new plant, give the maximum output from the plant and yet study the niceties of smokeless combustion—especially if, as is probable, the staff is depleted.

Kingstown.—L.G.B. Inquiry.—An inquiry has been held into the Council's application for sanction to a loan of £6,000 for the payment of the arbitration award and costs connected with the transfer of the electric lighting undertaking under the Electric Lighting Order Confirmation (No. 8 Kingstown) Act, 1914. No objection was offered. The award was for £3,608, and the costs and fees brought the total up to £4,704. The costs of the arbitration proceedings amounted to £603. The total expense was estimated at £6,327.

Liverpool.—Annual Accounts.—During the year ended December 31st last, the revenue of the electricity department amounted to £345,808, the balance to net revenue was £209,558, and after meeting interest and sinking fund contributions, and providing £50,000 to rate relief, £36,223 was transferred to renewals. The department has a reserve fund of £183,000 and a balance of renewals fund in hand of £97,000; the rate contribution represents about 3¼ per cent. on the unredeemed capital and 23 per cent. on the income derived from private lighting and power.

London.—Hackney.—As it is not possible to install two further boilers and economisers in the new boiler house to provide against breakdown, the Electricity Committee recommends that the stoker driving gear for the second boiler installation be provided immed ately.

Rawtenstall.—Bulk Supply.—With a view to giving a bulk supply of electricity to Haslingden a Sub-Committee recently recommended the borrowing of £11,000 for the purchase of new plant for the station at Hareholme. It has been decided, however, that for the present this scheme shall not be proceeded with, but that a cable shall be laid as far as Lockgate, and as much current as possible shall be supplied to Haslingden in that way. The estimated cost of this is about £2,000.

Redruth.—Street Lighting.—Owing to restricted lighting the U.D.C. is negotiating with the Urban Electric Supply Co. for a revision of the existing charges for public lighting.

Surbiton.—E.L. Purchase.—The transfer of the Council's electricity undertaking to Messrs. Callender's Cable and Construction Co., Ltd., has been completed. Messrs. Callender will pay £51,732, by instalments, as purchase price, and have already paid £4,100, to reimburse the Council's losses, and for other matters, including instalments of purchase money due to date of transfer.

Swinton and Pendlebury.—The Lancashire Electric Power Co. has notified the U.D.C. that the price of current would be advanced as from January 1st, in accordance with the advance in the cost of coal, as provided for in the agreement.

U.S.A.—Half-Watt Lamps.—According to the *Electrical World*, all the arc lamps in the city of New York are to be replaced by large gas-filled tungsten lamps, under the terms of the contracts entered into for 1916 with the different lighting companies supplying the city. The new gas-filled lamps will range from 100 C.P. to 400 watts in size, and the ordinary type tungsten lamps from 40 to 100 watts. During 1914 the city decided to discontinue the use of the flaming arc lamp; beginning with 1915 there were in service 18,211 arc lamps, many of which were replaced during the year by gas-filled tungsten lamps, while this year the remainder are to be replaced, resulting in a saving in the larger sizes of about $10 a lamp over the arc lamps replaced. Our contemporary adds that besides saving in money, it was found after a careful investigation that the gas-filled unit afforded a more uniform distribution of light, without glare or flicker, and had a much greater penetrating power in stormy or foggy weather.

The Inland Steel Co., Ind., is reported to have placed a million dollar contract with the Westinghouse Co. for steel mill electric plant, including two 5,000-KW. turbine sets, two fly-wheel motor-generator sets, two 3,000-H.P. motors and a 15,000-H.P. motor.

The Niagara, Lockport and Ontario Power Co. is contracting to deliver 40,000 H.P. to Niagara Falls manufacturing plants. This power will be supplied by the Ontario Power Co. from the Canadian side and used mostly for electro-chemical purposes.

West Ham.—Proposed Loans, &c.—In connection with the recent breakdown on the 5,000 KW. machine at the generating station, the engineer has made arrangements with the makers for the reconstruction of the electrical end of the machine on a more modern plan. The Committee recommends approval to the general principle of linking up with Poplar within the limits available at the present time. The engineer in the course of a report to his Committee, says he proposes that application should be made to the L.G.B. for sanction to borrow £3,000 for mains and £5,000 for sub-stations, transformers and switchgear, in order to cover amounts overspent, and to provide a balance to meet applications which may arise; £11,000 for increasing the capacity of mains in the Silvertown district required on account of the increasing demand by the Port of London Authority; £4,500 in connection with the linking-up scheme with Poplar; £3,275 in connection with the generating station, and £1,000 for meters. The Committee recommends the adoption of the report. The L.G.B. has given its consent to the borrowing of £2,000, being the balance unexercised on a sanction of £17,500 for services, &c.

TRAMWAY and RAILWAY NOTES.

Australia.—The N.S.W. Public Works Department has in contemplation four additional tramways in the Sydney area, at a cost of £164,000. The lines are from Bondi Road to Bronte, along Cooks River Road to connect with the Gardeners Road line, and from Burns Road to Ryde.

Bispham.—The Blackpool Corporation is in negotiation with the Blackpool and Fleetwood Tramroad Co., as an interested party, with regard to a scheme for the building of a sea wall north of Blackpool, to arrest the erosion of the cliffs. The Bispham U.D.C. feels itself too small a body to undertake such a large expenditure—about £25,000—and has approached the Corporation with a view to an extension of its boundaries, so as to absorb Bispham.

Birmingham.—Trailer Cars.—The Tramway Committee has instructed Mr. Baker, the general manager, to inquire into the use of trailer cars on the London tramways with a view to their possible introduction in Birmingham, where the shortage of drivers is causing some concern.

Eccles.—Tramway Surplus.—There was a surplus of £2,220 on the tramway account for the year ended March 31st last; £572 of this has been appropriated for street improvements account, and the balance of £1,647 has been carried to the reserve fund.

Glasgow.—In order to comply with the terms of the restricted lighting order, the Tramways Committee has had the windows of the cars painted halfway down. In addition, nearly 20,000 lamps have been dipped, and measures are to be taken to dim the lamps on the forepart of the cars so far as is consistent with the public safety, and to dull the illuminated signs.

Halifax.—The B. of T. has extended the period for the completion of certain tramways authorised by the Halifax Corporation Act, 1911, for one year from August 18th, 1916.

Hull.—Tramway Surplus.—The income of the Corporation tramways up to March 31st next is estimated at £162 890, and the credit balance, after meeting all charges, at £13,762, against £19,112 in the previous year. It has been decided to grant £10,000 to the relief of the rates, as in previous years. During the year ½d. fares have been maintained and some five million free rides given to soldiers, &c. The department has a reserve fund of £143,000.

Lancs. & Yorks. Railway Electrification.—Sir George Armytage, chairman of the board, stated at the annual meeting of the shareholders on February 16th, that the electrification of the Manchester and Bury line was now almost complete, and that the electric trains would be gradually brought into use at an early date. The statement of receipts and expenditure on capital account showed that on electric power stations, &c., the company had expended up to December 31st, 1914, the sum of £392,804, and during 1915 £112 871 was expended, making a total of £505,676 on this head. Estimated further expenditure on capital account included £17,500 during the current year on the electrification of the Manchester and Bury line, and £6,500 subsequently; and £28 400 on electric power stations, &c., during 1916, and £5,500 subsequently. Under the heading of rolling stock, detailed figures were given respecting the trains worked by electric power, from which it appears that the number of cars had increased during the past year from 174 to 210, and the carrying capacity from 13,616 seats to 16,552 seats.

London.—Poplar.—Electric Wagon.—The Electricity Committee has recommended the B.C. to purchase, for joint use with the Works Department, a 4-ton Edison electric wagon, and a 4-ton Foden steam wagon. The total cost is estimated by the Committee at £2,000.

London and North-Western Railway Electrification.—The engineer's report on the progress of the work up to February 10th states that the bridges and tunnels for the junctions between the new electric lines and existing lines to Euston and Broad Street are in progress, and half the length of the iron-lined tunnels under Primrose Hill has been completed. The electric power station and repair shed at Stonebridge Park and six electric sub-stations are complete, and part of the plant has been installed, and the equipment of the new lines for electric traction between Willesden and Watford is in a forward state.

The electrical equipment of the North London, Hampstead Junction, and North-South Western Junction lines, which form the through route between Broad Street and Kew Bridge and Richmond, is being proceeded with, and the buildings for the sub-stations on these lines are complete.

Manchester.—Female Labour.—About 250 women are now employed on the Corporation cars, and others are being appointed to fill the places of men called to the army under the group system.

Monmouthshire.—The Board of Trade has extended the period of the Western Valleys (Monmouthshire) Railless Electric Traction Act, 1913, for one year.

U.S.A.—Electric Truck Parade.—An unusual demonstration occurred in December last, in Chicago's "loop" district, when 89 electric trucks, loaded with tea and coffee, paraded in the streets to mark the inauguration of exclusive electric truck delivery service by Messrs. Reid, Murdock & Co., wholesale grocers. The procession was accompanied by mounted police, and a band enlivened the proceedings—in American fashion. The goods were consigned to 1,920 customers in 875 cities in the States, and the result was "some" advertisement. But we wonder what would happen were a London firm to suggest a similar demonstration in the City!

60,000-kw. Turbines.—The Interborough Rapid Transit Co., of New York, is considering bids for two 60 000-kw. steam turbo-alternators, which, according to the *Electrical World*, will each be made up of three separate electric generators driven by one high-pressure and two low-pressure turbines, the latter being connected in multiple. Apparently it has not been decided yet whether to install 60,000-kw. units or the equivalent in 30,000-kw. units.

Walthamstow.—The Tramways Committee recommends a revision of the fares and fare stages, including an increase of 50 per cent. on the prices of workmen's tickets. Having been advised by the contractors for the supply of tickets that the restriction of the importation of wood pulp would result in them being able to supply only 50 per cent. of the usual requirements of tickets, the District Council has been recommended to communicate with the Board of Trade, pointing out that the proposed allowance would place the undertaking in considerable difficulty, and asking the Board to withdraw the restriction as far as tramway undertakings are concerned.

West Ham.—Halfpenny Fares, &c.—The tramways manager recommends the pulling up of the Beckton Road tramway, and the relaying of as many rails as are required in the doubling of the Connaught Road terminus track. The manager estimates the cost of this doubling at £970, the cost of pulling up the rails in Beckton Road and making good the roadway at £350, and the value of the rails, fish plates, &c., recoverable at over £2,000. The manager has submitted an exhaustive report on fares and stages, in which he recommends, *inter alia*, the abolition of the halfpenny fare. He estimates the cost of new track work requiring to be put in hand as soon as possible at about £100,000, and is of opinion that some action should be taken to increase revenue. Whereas the actual cost of carriage per passenger works out at 67d., excluding capital charges, 47 per cent. of the total number carried only pay one halfpenny. The halfpenny fare at West Ham, with the exception of one year, has never covered actual running costs. A scale of fares should be made which gives the journey desired at not less than cost price, and should be periodically revised in accordance with the requirements of the financial side of the undertaking. The Committee recommends the Corporation to put into operation the following fares on all cars running in the borough as and from the beginning of the next financial year:—(1) A universal 1d. fare for a continuous journey on any one car; (2) a 1½d. workmen's return fare for a continuous journey on any one car; (3) existing through fares where necessary to be adjusted to comply with the above scheme; (4) children's stages to remain in force as at present.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdare.—March 8th. Electrical goods, for the Powell-Duffryn Steam Coal Co. Stores Manager, Aberaman offices.

March 11th. U.D.C. Electrical stores for 12 months. See "Official Notices" February 18th.

Australia.—Sydney.—May 1st. Two 800-kw. turbo-alternators, condensers, switchboard, &c., for the pumping station at Ryde, for the Metropolitan Board of Water Supply and Sewerage at Sydney.*

May 3rd. N.S.W. Railways and Tramways Department. One 2,500-kw. turbo-alternator, for Zata Street, Newcastle, power house. Specifications (20s.) from the Engineer's office, 61, Hunter Street, Sydney.*

Melbourne.—April 19th. Victorian Railways. One 1,000-amp.-hour storage battery, plant for impregnating electrical apparatus with insulating varnishes, &c.*

Belfast.—March 15th. Tramways and Electricity Committee. Stores, including a number of electrical items. See "Official Notices" to-day.

Birkenhead.—March 6th. Corporation. Cable and two rotary converters with switchgear. See "Official Notices" February 1st.

Bolton.—March 2nd. Electricity Committee. Stores, including some electrical items. See "Official Notices" Feb. 11th.

March 6th. Tramways Committee. Stores, including lamps, carbons, &c. See "Official Notices" to-day.

Dewsbury.—Electricity Department. Two second-hand 250-kw. generator panels, oil separator, piping, cables, &c. See "Official Notices" February 11th.

Dover.—March 9th. Electrical sundries and cables, for the Harbour Board. (Schedules 2s. 6d. each.) Mr. Martyn Mowll, Registrar, Castle Street.

Dublin.—March 1st. Battery materials for carriage lighting, for the G.N. Railway Co. (Ireland). See "Official Notices" February 18th.

Dundalk.—March 21st. U.D.C. Engine-room stores, cables, lamps, &c., for the Electricity Department. See "Official Notices" to-day.

Edmonton.—March 8th. Electric lamps for six months, for the B. of G. Mr. F. Shelton, Clerk, Lower Tottenham.

Heston and Isleworth.—March 11th. U.D.C. Electrical supplies, including cables, meters, &c. See "Official Notices" to-day.

Heywood.—March 15th. Electricity Committee. Stores, including some electrical items, for 12 months. See "Official Notices" to-day.

Keighley.—30-H.P. electric motor installation for pump driving, for the Fleece Mills Co., Ltd. See "Official Notices" February 18th.

Manchester.—March 7th. G.C. Railway Co. Stores, including electrical items. Stores Superintendent, Gorton.

New Zealand.—DUNEDIN.—May 17th. City Council. (1) Tramcar bodies; (2) electrical equipment. Plans, &c., from the Town Clerk, Dunedin.*

Plymouth.—March 2nd. Corporation. Converter with starter. See "Official Notices" February 18th.

Pontypridd.—March 13th. U.D.C. Twelve months' supply of electrical stores for the Electric Light and Tramways Department. See "Official Notices" February 18th.

Spain.—Municipal authorities of Esguevilla (Province of Valladolid). Tenders for the concession for the electric lighting of the town during a period of four years.

Swansea.—March 6th. Education Committee. Electric lighting installation at Brynmill and Cwmbwrla Council Schools. See "Official Notices" February 18th.

West Ham.—March 22nd. B. of G. Three months' supply of electric fittings. Clerk, Union Road, Leytonstone.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Government Contracts.—List of new contracts for January, 1916:—

Electric cable and wire.—British Insulated and Helsby Cables, Ltd; I. Frankenburg & Sons, Ltd.; Hooper's Telegraph and India-Rubber Works, Ltd.; Johnson Matthey & Co., Ltd.; Johnson & Phillips, Ltd.; Liverpool Electric Cable Co.; St. Helens Cable & Rubber Co., Ltd.; Siemens Bros. & Co., Ltd.
Generating sets.—Aster Engineering Co., Ltd.; Austin Motor Co. (1914), Ltd.
Elect ic lamps.—Balfour, Baring, Ltd.
Switches.—Berry & Hayward, Ltd.
Terminals and electrical instruments.—British L. M. Ericsson Manufacturing Co.; Johnson & Phillips Ltd.
Works services.—Electric Light at Crowlarns Camp, Barrow-in-Furness, E. M. Evans & Sons, Ltd.; electric light installation at Haynes Park, Girdlestone & Co.; electric lighting at Bridge of Allan, Mackenzie and Moncur; electric lighting at Kenross, Mackenzie & Moncur; electric lighting at Dunfirmline, Grindlay, Ross & Co., Ltd.; installation of electric lighting, bells, &c., at War Hospital, Bath, N. G. Middleton; power house, &c., at Lilbourne, Girdlestone & Co.

H.M. OFFICE OF WORKS.

Motor-generator, &c., at Research Building, Teddington.—Vickers, Ltd.
Supply of electric cable and wire during 1916.—General Electric Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.

POST OFFICE.

Telephone apparatus.—Automatic Telephone Manufacturing Co., Ltd.; Western Electric Co., Ltd.
Insulator brackets.—Bullers, Ltd.
Telephone cable.—Union Cable Co.
Repeating coils.—Western Electric Co.
Flexible cords.—British Insulated and Helsby Cables, Ltd.
Earthenware troughing.—Doulton & Co., Ltd.
Lead tubs.—G. J. Chatterton, Ltd.
Bronze wire.—T. Bolton & Sons, Ltd.; F. Smith & Co. (incorporated in the London Electric Wire Co. and Smith's, Ltd.)

London.—POPLAR.—Tenders received by the Electricity Committee for switchgear for linking up with Hackney:—

British Westinghouse Co.	(recommended)	£1,498
Siemens Bros.		1,504
Johnson & Wright, Ltd..		1,621
Ferranti, Ltd.		1,750

Midland Railway Co.—Contract for Osram drawn-wire lamps for 12 months, placed with the General Electric Co., Ltd.

Reading.—Borough Education Committee. Wiring work, &c., for the X-ray apparatus at the School Clinic: Reading Electric Supply Co., Ltd.

Southend-on-Sea.—T.C. Two years' supply of coal for the electricity works, with an option of about 10,000 to 11,000 tons a year: Foster & Co.

Walthamstow.—District Council. Coal for the electricity works for 12 months, 50 tons per week: Myers, Rose & Co.

FORTHCOMING EVENTS.

North-East Coast Institution of Engineers and Shipbuilders.—Friday, February 25th. At 7.30 p.m. At the Bolbec Hall, Newcastle-on-Tyne. General meeting.

Association of Mining and Electrical Engineers (Notts and Derbyshire Branch).—Saturday, February 26th. At 3.30 p.m. At University College. Paper on "Static Transformers," by Mr. C. Jones.

Manchester Association of Engineers.—Saturday, February 26th. At the Grand Hotel, Aytoun Street. Paper on "Cast Steel as a Material of Construction," by Mr. E. F. Lange.

Battersea Polytechnic, Battersea, S.W.—Saturday, February 26th. At 7 p.m. Annual conversazione and inspection of students' work.

Junior Institution of Engineers.—Saturday, February 26th. At 3 p.m. At the Holborn Restaurant. Concert in aid of the British Red Cross Society. Tuesday, February 29th. Lecture on "Chemistry and Engineering," by Prof. H. E. Armstrong, F.R.S.

Post Office Telephone and Telegraph Society of London.—Monday, February 28th. At 6.30 p.m. At the I.E.E., Victoria Embankment, W.C. Paper on "Loading of Telephone Circuits," by Mr. A. B. Hart.

Association of Supervising Electricians.—Tuesday, February 29th. At 7.15 p.m. At St. Bride's Institute, Bride Lane, E.C. Paper on "Illuminating Engineering," by Mr. L. Gaster.

Institution of Electrical Engineers.—Wednesday, March 1st. At 5 p.m. At the Institution. Special general meeting of corporate members.

Institution of Electrical Engineers (Students' Section).—Wednesday, March 1st. At 7.45 p.m. At Victoria Embankment, W.C. Discussion on "Suggested Applications of Science to Warfare," opened by Mr. R. E. Dickinson.

Chemical Society.—Thursday, March 2nd. At 8 p.m. At Burlington House, Piccadilly, W. Ordinary scientific meeting.

Greenock Electrical Society.—Friday, March 3rd. At 7.45 p.m. At the Temperance Institute, 19, West Stewart Street. Paper on "The Life of Sir Charles Wheatstone," by Mr. A. R. Macaulay.

Royal Institution of Great Britain.—Friday, March 3rd. At 5.30 p.m. At Albemarle Street, Piccadilly, W. Lecture on "Corona and other Forms of Electric Discharge," by Prof. Silvanus P. Thompson, F.R.S.

NOTES.

The Accurate Use of Technical Terms.—An engineering correspondent writes as follows:—It is with regret that one frequently sees the meaning of words blurred owing to continued wrong usage. Often one wishes for an English Academy to watch over our language in order to prune away such excrescences as they appear. The journalistic use of the word "decimate" provides a case in point. Its real meaning is to kill a tenth part, but now it is used as equivalent to annihilate! In engineering we often find the word "bearings" applied to that part of the shaft which runs in a bearing; surely a confusing term, when the bearing is obviously the fixed part which bears or supports the shaft. The part of the shaft in the bearing should always be called the journal. The word "rate" now shows signs of going wrong, being used with two quite contradictory meanings. In a recent REVIEW article on Electric Lifts, the author writes as follows: "The resistance should be amply rated. . . so that they cannot be damaged if run for long periods with resistance in circuit." On the other hand, in connection with Prof. Field's recent I.E.E. paper, it was pointed out in the discussion that a turbo-generator which the Americans would rate at 20,000 KW., in England would be rated at 14,000 KW. In the first case the words "ample rating" mean of ample proportions, while in the second case the word rate has the opposite meaning. A most entertaining, not to say expensive, law-suit could thus be built upon the contrary uses of the word "rate," where the consultant had specified that the machine was to be amply rated, and where the maker had supplied plant of meagre proportions. One lot of experts would declare that, in engineering circles, ample rating means ample proportions, while the other side would produce equally eminent experts and also dictionary makers to prove that the words certainly mean that the materials had to be worked to their uttermost, and weight kept down.

What is the proper meaning of the word "rate"? The Standard Dictionary gives as the meaning of the word "To set an estimate upon, especially with reference to other similar things."

Hence a low-rated machine is one from which one does not expect very much, while a highly-rated machine is one from which one expects a great deal. The writer, therefore, submits that the meaning in Prof. Field's discussion is the correct one, and that an amply-rated machine is one having small proportions and heavy stresses.

How are we to express the intention of the author of the Electric Lift article so as to bear elucidation by the lawyers? Some makers advertise their motors as being liberally rated, and others state that theirs are conservatively rated. Doubtless, this is the unique case where the words conservative and liberal have the same meaning, but it does not seem likely that either of them in this connection would satisfy a judge.

Probably the best way would be to state that the machine must have proportions ample for the work specified, and that the stresses must be low. One might say that the rating must be low, but while correct it will be better to avoid this expression until the word is no longer used wrongly.

Our American friends have a way of stating that the construction of their plant is "rugged." To us this seems to mean that the workmanship is rough and unfinished, but a reference to the Standard Dictionary shows that in the U.S.A. the word "rugged" is used with the meaning "Possessing vigorous health, robust, sturdy." That is picturesque, like many Americanisms, but the Englishman will do well to avoid it. He might find that makers in this country interpret it as having the other meaning, namely, "having a surface full of abrupt inequalities or projections."

Institution and Lecture Notes.—Institution of Electrical Engineers.—The Kelvin lecture which was delivered by Dr. C. Chree, F.R.S., on the 17th inst., was devoted to "Terrestrial Magnetism," a subject which had been dealt with by Lord Kelvin in connection with his important changes in the design of the mariner's compass, and with the possible relation between terrestrial magnetic storms and solar influence. Lord Kelvin in 1863 showed that if the sun's magnetisation were 120 times as intense as that of the earth, its complete reversal, if that were possible, would only produce a disturbance of 1′ in declination. He next referred to the subject in 1892, when he devoted fully half of his Presidential address to the Royal Society to terrestrial magnetism; he then stated that in order to produce appreciable disturbances the sun must be a magnet of 12,000 times the intensity of the terrestrial magnet, but held that even if the magnetic force of the sun were perceptible here, it was vastly less in amount than the abruptly varying force which was required to account for the magnetic storms which were apparently associated with the occurrence of spots on the sun. Further, he gave reasons which, to his mind, were absolutely conclusive against the supposition that terrestrial magnetic storms were due to the magnetic action of the sun, the expenditure of energy at the sun necessary to produce the observed results being inconceivably enormous.

However, Dr. Chree points out that Lord Kelvin's conclusion has little bearing on the theories of solar action mainly current to-day, which attribute the magnetic storms to the presence in the earth's atmosphere of something bearing an electric charge, originally projected from the sun.

The lecturer then discusses in turn the secular change, the solar diurnal variation, and the phenomena of magnetic disturbances, of which subjects, as Superintendent of the Kew Observatory, he is one of the foremost investigators.

The lecture forms a very important contribution to the literature of this subject, which may seem abstruse at the moment, but, like the phenomena of static electricity in connection with wireless telegraphy, high-pressure transmission, &c., may become of immense importance to electrical engineers in the not distant future.

Physical Society of London.—At the annual general meeting, held on February 11th, the reports of the Council and of the treasurer were adopted. The following officers were elected for the ensuing year:—President, Prof. C. V. Boys, F.R.S.; Vice-Presidents, Messrs. W. R. Cooper and F. E. Smith, Dr. S. W. J. Smith and Dr. W. E. Sumpner, D.Sc.; Secretaries, Dr. W. Eccles and Dr. R. S. Willows; Foreign Secretary, Dr. R. T. Glazebrook; Treasurer, W. Duddell, F.R.S.

Papers were read "On a General Bridge Method for Comparing the Mutual Inductance between Two Coils with the Self-Inductance of One of Them," by Prof. C. H. Lees F.R.S., and on "An Enclosed Cadmium-Vapour Arc Lamp," by Dr. H. J. S. Sand. The lamp is similar to the mercury lamp, and is constructed of quartz glass. To start the lamp, the metal is melted by means of a Bunsen burner, and the arc is struck by tilting. Before introduction into the lamp the metal is freed from oxide and dissolved gases by a special process of filtration while at the pump. It is prevented from adhering to the glass, which might lead to fracture, by the presence of a small amount of a loose powder in the lamp. The lamp gives a powerful light, and, once started, will continue burning indefinitely.

Two slides were shown by Dr. S. Russ, showing the ultra-violet spectrum of the Simpson arc and that of pure tungsten. It was evident that the spectrum of the former was almost wholly due to tungsten.

Dublin Electricity Supply.—As we go to press we have received the following letter:—"We notice in your issue of February 18th a summary of Mr. P. W. d'Alton's report on the Dublin electricity undertaking, and a reference to the steam turbine supplied by us. In view of the recommendation put forward in the report that the turbine should be reconstructed, and to remove any misapprehension, we beg to put on record that the turbine referred to was supplied by us nine years ago. As you are well aware, considerable improvements have been made in turbine design since this machine was supplied, resulting in increased economy.

For RICHARDSONS, WESTGARTH & CO., LTD.
M. G. S. SWALLOW.

Hartlepool, *February 23rd*, 1916.

The War and Electrical Goods.—On Wednesday, in the Bow County Court, before his Honour Judge Graham, K.C., Mr. G. J. Wilson, of Liverpool, dealer in electrical appliances, sought to enforce the payment of a judgment debt of £16 10s. 9d. from J. Goldberg, trading as the Anglo-Russian Electrical Supply Co., of 99, Woodstock Street, Canning Town. Mr. Daybell, who appeared for the plaintiff, said the case was bordering on fraud. The defendant extensively advertised electrical goods, and the plaintiff sent money along for them, but never got the things, nor had he had his money back. The defendant was cross-examined, and admitted that prior to the war, and up to about a twelvemonth ago, he did advertise very largely, but now his business had been completely ruined owing to the fact that so little electric light was used. The darkening of London had ruined him, as it had a good many others. He agreed that in April, 1915, he advertised 50,000 Excello carbons for sale at £1 a 100, but, as a fact, he had to dispose of them at 2s. 6d., and even as low as 1s. 6d. Before the war he used to get quite a number of these lines, but now he could do nothing. He thought he could pay 5s. a month. Judge Graham: 5s. is better than nothing, and that is my order for 12 months, with 10 days' imprisonment in default. In reply to Mr. Daybell, he allowed his client's costs from Liverpool.

A Turbo-Generator Steam Consumption Test.—The following corrections were received from the author of the article on pp. 240-241 after those pages had gone to press:—

Table I.—185 lb. pressure—allowance, ·125 per cent.

TABLE III.

Per cent. of atmospheric pressure.	Allowance to be made, + per cent. — per cent.
85	+ 1·9
86	+ 1·72
87	+ 1·53
88	+ 1·34
89	+ 1·15
90	+ 0·96
91	+ 0·76
92	+ 0·58
93	+ 0·40
94	+ 0·20
95	·00
96	− 0·26
97	− 0·42

Volunteer Notes.—ENGINEERING INSTITUTIONS' V.E.C.—Orders for week commencing February 28th, 1916.—By Lieut.-Col. C. B. Clay, V.D., Commanding.

Saturday, February 26th.—Uniform Parade, 2.45 p.m.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Monday, February 28th.—Sections 1 and 2, Technical; Sections 3 and 4, Lashings and Trestle Bridging, Signalling Class and Recruits.

Tuesday, February 29th.—School of Arms, 6 to 7 p.m.

Thursday, March 2nd.—Shooting for Sections 3 and 4.

Friday, March 3rd.—Sections 3 and 4, Technical; Sections 1 and 2, Lashings and Trestle Bridging; Signalling Class and Recruits.

Saturday, March 4th.—Adjutant's Instruction Class at 2.30 p.m.

E. G. FLEMING,
Company Commander and Acting Adjutant.

3RD BATT. (OLD BOYS) CENTRAL LONDON VOLUNTEER REGIMENT.—Battalion Orders by Capt. R. J. C. Eastwood (Sub-Commandant), Thursday, February 24th, 1916:—

Week-end Parades.—Saturday.—The Battalion will parade at Wembley Park at 3.15 p.m. for drill under Company Officers. "Derby" recruits are invited to attend.

Sunday.—The Battalion will parade at Liverpool Street Station (low-level entrance, G.E.R.) at 9.30 a.m., and proceed by train for Entrenching duties. Members will carry their own lunch. The Battalion will return to town about 6 p.m.

Musketry.—Acton Range will not be open on Saturday, 26th inst. A Match will be shot at Bisley on Saturday, Sergeants *v.* Privates. Men to Parade in uniform, at 12.45 p.m., Waterloo Station, No. 6 Platform.

A. G. JOINER, *Major and Adjutant*, O.B.C.

ELECTRIC SMELTING OF IRON ORES IN SCANDINAVIA.

Introduction.—We are indebted to the enterprise of the Canadian Department of Mines for a most useful report on the present state of the electric smelting of iron ores in Sweden and Norway (Notodden), which Dr. Alfred Stansfield has drawn up as a result of a visit of inspection made in the summer of 1914. The purpose of the investigation was to take particular note of the economics of the operation of the furnaces in use, in view of the possibility of establishing an electric pig-iron industry in Canada.

Types of Furnaces in Operation.—Two main types of furnace are at present in use for smelting iron ores: (1) The Elektrometall furnace; (2) Furnaces of the Helfenstein type. The following tables give a list of the 13 furnaces in operation and the 10 in course of construction in June, 1915:—

I.—ELEKTROMETALL FURNACES.

	In operation.	*Building.*
Domnarvet	2 of 3,000 H.P. 1 of 6,000 H.P.	—
Söderfors	—	3 of 3,000 H.P.
Ljusne	—	1 of 3,000 H.P.
Hagfors	3 of 3,400 H.P.	3 of 3,400 H.P.
Nykroppa	—	2 of 3,400 H.P.
Trolhättan	1 of 3,000 H.P.	1 of 3,000 H.P.

In the far north of Sweden a large iron-works of 25,000 H.P. is to be constructed immediately.

II.—HELFENSTEIN AND TINFOS FURNACES.

Domnarvet	1 of 5,000 H.P. 1 of 7,000 H.P.
Notodden (Norway)	4 of 1,600 H.P.
Ulefos	1 small furnace.

The Elektrometall Furnace.—The feature of this furnace is that the ore is preheated, and partially reduced in a large shaft before it reaches the smelting chamber, the heating and reduction being materially assisted by the circulation of the furnace gases, which

is characteristic of this furnace. In the most recent examples the crucible is circular, and is lined with fire-brick, and it is provided with only one tapping-hole for both slag and metal, which are separated by a dam as they flow. The arch of the crucible, constructed of fireclay bricks, is cooled below by the cool gases from the top of the furnace, and also by cold air. The stack of the furnace is constructed in a steel shell, and is supported on steel beams independently of the crucible. The shaft is reduced to a neck where it enters the crucible, but the tendency is to increase the width of this to facilitate the passage of gases. The electrodes, which are circular, about 2 ft. in diameter, and 4 or 5 ft. long, enter the furnace through the arch just outside, and concentrically with the neck. The larger furnaces have six electrodes, which, supported by rollers, lie between two inclined guides. At the bottom of the guides is a water-cooled collar, built into the furnace arch, but supported from above, and above this collar is a water-cooled contact ring made up of a number of metal blocks forming a flexible collar round the electrode. These blocks are connected by cable to the bus-bars. A clamping ring above the contact ring serves to feed the electrodes, which do not, as a rule, need moving more than once in two or three days.

The furnaces with six electrodes are supplied from three transformers with three-phase current, each transformer being connected to diametrically opposite electrodes, so that the current tends to pass between these rather that between adjacent electrodes. The regulation of the current is effected by varying the supply voltage on the primary side, and not by moving the electrodes.

To circulate the furnace gases, the gas withdrawn from the top of the furnace is filtered, washed and dried, and returned—either through a Roots blower or else simply by means of the rotary washing fan—to the furnace through six tuyeres, entering beneath the furnace arch and between adjacent electrodes. Increasing the circulation raises the temperature in the shaft, facilitates the reduction of the ore, raises the percentage of CO_2 in the escaping gases and increases the economy of electric power and of fuel, but it also increases the consumption of the electrodes. An important economy in operation will be effected when the escaping gases are utilised for heating open-hearth furnaces.

The Swedish iron industry consists principally in smelting the pure native ores with charcoal in blast furnaces. The industry is profitable, because the pig-iron produced is of high quality and commands a high price. Now the electric furnace can compete very favourably with these blast furnaces, first, because they are small; secondly, because the electric furnaces yield better metal; and finally, because only about one-third of the charcoal is consumed in the latter for the same yield of iron. The Elektrometall furnaces are small, too; the 4,000-H.P. unit at Domnarvet yields only some 30 tons daily, yet the cheap Swedish water power renders the cost of making iron less than in the charcoal blast furnaces. Attempts to use coke instead of charcoal in the Elektrometall furnace have so far been unsuccessful, although further experiments are being made in this direction by building the furnace shaft wider and lower.

Efficiency of the Elektrometall Furnace.—The Report contains some fully-detailed accounts of the working of the furnaces which were inspected, as regards power and material consumption, heat distribution, and output. We can only summarise them very briefly here.

The power is supplied at some 10,000 volts and transformed to 80 or 90 volts at the furnace terminals. The energy consumed for auxiliary purposes—motors and lighting—is some 2½ per cent. of the whole supply. Neglecting transformer losses, the furnaces utilise during operation about 90 per cent. of the power supplied, and some 82 or 83 per cent. of the gross amount paid for, allowing for holidays and stoppages for repairs. This figure would be considerably higher—say, 90 per cent.—if three or four furnaces were worked together

The amount of electrical energy to be paid for (on the above 82 per cent. basis) to produce 1 ton of pig-iron works out at 0·41 H.P.-year utilising 60 per cent. ores and 0·47 H.P.-year for only 50 per cent. ores. These figures are for basic Bessemer or acid open-hearth iron. To make grey foundry pig about one-half of a H.P.-year is at present required.

The consumption of charcoal may be taken as 340 kg. per ton of white pig, and 370 kg. per ton of grey pig-iron.

The consumption of electrodes varies considerably, but it has been reduced as low as 3 kg. per ton of iron; an average figure is 5 or 6 kg.

The circulation of gases in the Elektrometall furnace economises the consumption of charcoal, but it increases that of electrodes.

(To be continued.)

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—Mr. A. R. Fox, who has resigned his position as shift engineer at the Macclesfield electricity works, will take up the post of resident engineer-in-charge at Chippenham electricity works a month hence.

On February 23rd, at Sheffield, Mr. F. P. Seager, of the engineering staff at the Manchester Corporation electricity works, was married to Miss Edith Maude Warburton, of Sheffield.

The Blackburn Electricity Committee has decided to increase the salary of Mr. Wheelwright, the electrical engineer, by £100 per year, bringing it up to the level of salaries paid to other officials of similar standing.

General.—Mr. W. Hooper, formerly on the staff of the Lynton (Devon) electricity works, was on H.M.S. *Arethusa* when she was mined, and was saved.

The *London Gazette* contains the following announcements:—Territorial Force: The undermentioned to be temporary captains: Second-Lieutenants (temporary Lieutenants) T. F. Middleton-Case, G. R. Madge, and M. G. Bland. The following Second-Lieutenants to be temporary Lieutenants: H. G. G. Clarke, Cecil H. S. Evans, W. H. Mather, G. E. Owles, E. O. Levett, and T. H. Gotch. Lance-Corporal A. S. Gill to be Second-Lieutenant (on probation).

Mr. J. G. Balsillie has vacated the post of radio-telegraph engineer to the Australian Commonwealth Government, to which he was originally appointed in 1911, for three years, for the purpose of establishing and developing a wireless system for Australia. His term expired last year, but in consideration of the vital importance of wireless telegraphy during the war, it was extended a further year. The system adopted by the Federal Government is the invention of Mr. Balsillie, and the originality of its distinguishing features has been recognised by its former disputants, the Marconi Co. Mr. Balsillie, however, placed the system absolutely at the disposal of the Federal Government, and has so far received no monetary consideration on its account. Mr. Balsillie will concentrate his attention on the artificial production of rain.—*Australian Mining Standard.*

Roll of Honour.—Lieut. Harry Marsh, who has been killed in action in France, was with the Lancashire Electric Power Co., Manchester, before the war.

Private Reginald Lightfoot, of Crewe University and Public Schools Battalion, who has been killed in action, was in the electrical department at Crewe Railway Works.

Sergeant E. J. Berry, formerly employed by the Chloride Electrical Storage, Ltd., Clifton Junction, is in hospital suffering from shell shock.

Rifleman Harry Scattergood, formerly in the electricity department of the Co-operative Wholesale Society, Trafford Park, has died from wounds received in action.

Obituary.—Mr. A. L. Sabine.—We learn with deep regret of the death of Mr. Alfred Louis Sabine, which occurred on Sunday last, at Herne Bay, at the age of 75 years. The deceased gentleman was for 50 years in the service of Messrs. Siemens Bros. & Co., Ltd., for 30 years (from 1880 to 1910) holding the position of secretary, from which he retired six years ago. Mr. A. L. Sabine was a brother of the late Mr. Robert Sabine, the eminent civil and electrical engineer. In our youthful days we were personally in constant touch with him, and we remember him as a man of most gentle and retiring disposition, with whom it was a pleasure to converse.

Will.—Mr. Geo. Angus, of Geo. Angus & Co., Ltd., belting manufacturers, left £24,541.

NEW COMPANIES REGISTERED.

Lower Thames Land Development and Power Co., Ltd. (143,059).—This company was registered on February 18th, with a capital of £7 in £1 shares, to acquire and turn to account a certain estate at Barking, Essex, fronting on the River Thames, containing 308 acres. The subscribers (with one share each) are: J. B. Braithwaite, 27, Austin Friars, E.C., stock and share broker; H. B. Renwick, Burnham, Chartfield Heath, S.W., director; F. W. Reynolds, Acorn Works, Edward Street, Blackfriars, S.E., director; F. C. M. Brown, 44, Marlborough Hill, N.W., secretary; G. Tweedie, 42, Palmerston Crescent, Palmer's Green, N., accountant; G. Scott, 30, Gloucester Terrace, Hyde Park, W., engineer; T. W. Cole, 44, Rose Hill Road, Wandsworth, S.W., secretary. Private company. The number of directors is not to be less than three or more than seven; the first are J. B. Braithwaite, H. B. Renwick, and F. W. Reynolds. Qualification, one share. Remuneration, £600 per annum, divisible. Registered office: Moorgate Court, Moorgate Place, E.C.

Coates and Co. (Sheffield), Ltd. (143,006).—This company was registered on February 14th with a capital of £3,000 in £1 shares (500 pref.), to take over the business of an electrical engineer and contractor carried on by J. Coates, at 345, Glossop Road, Sheffield, as Coates & Co. The subscribers (with one share each) are: J. Coates, 345, Glossop Road, Sheffield, electrical engineer; Mrs. M. A. Coates, 5, Peel Terrace, Sheffield. Private company. The number of directors is not to be more than five; J. Coates is first permanent director. Qualification, £100. Solicitor: C. Crowther, 23, Abingdon Street, Westminster. Registered by Jordan & Sons, Ltd., 116-117, Chancery Lane, W.C.

Scientific Inventors' Syndicate, Ltd. (143,070).—This company was registered on February 19th, with a capital of £1,000 in £1 shares, to experiment with, manufacture, and develop methods and means of light, heating, and ignition, produce and destroy gases, produce neutralising effects by electrical, chemical, or mechanical means, and to use, manufacture, aid in, and turn to account by-products and waste material. The subscribers (with one share each) are: F. Harrison, 12, Barry Road, East Dulwich, S.E., electrical engineer; F. L. Harrison, 12, Barry Road, East Dulwich, S.E., electrical engineer. Private company. The number of directors is not to be less than two or more than five; the first are F. Harrison (permanent chairman) and F. L. Harrison. Qualification, £50. Remuneration as fixed by the company. Registered office: 83, New Street, Kennington, S.E.

Makin and Co., Ltd. (143,007).—This company was registered on February 14th, with a capital of £1,000 in £1 shares, to carry on the business of electrical and mechanical engineers and manufacturers, workers and dealers in electricity in all its branches, &c., and to adopt an agreement with Makin & Co., Ltd. (in voluntary liquidation) and P. Toothill. The subscribers (with 10 shares each) are: R. C. Smith, Mill Mount, Tuxford, retired grocer; R. C. Smith, Jun., 2, Anstey Road, Sheffield, electrical engineer. Private company. The number of directors is not to be less than two or more than five; the first are R. C. Smith and R. C. Smith, Jun. Qualification, 10 shares. Registered office: 39, Townhead Street, Sheffield.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Colston Electrical Works, Ltd.—Mortgage on certain moneys, dated January 25th, 1916, to secure all moneys due or to become due from company to Capital & Counties Bank, Ltd., Clare Street, Bristol.

Mawdsleys, Ltd.—Capital, £20,000 in £1 shares. Return dated January 5th, 1916. 18,937 shares taken up; £6,937 paid; £12,000 considered as paid. Mortgages and charges: £6,300.

Telephone Co. of Egypt, Ltd.—A memorandum of satisfaction to the extent of £700 on February 1st, 1916, of debenture stock covered by trust deed dated July 27th, 1904, and three supplemental deeds of acknowledgment dated Feb. 21st, 1906, March 4th, 1908, and October 27th, 1909, securing £200,000, has been filed.

Oriental Telephone and Electric Co., Ltd.—A memorandum of satisfaction to the extent of £1,450 on February 1st, 1916, of debenture stock covered by trust deed dated June 28th, 1905, and a supplemental deed of acknowledgement dated June 12th, 1907, securing £200,000, has been filed.

Sun Electrical Co., Ltd. (63,261).—Capital, £45,400 in £1 shares (20,000 pref.). Return dated December 28th, 1915. 17,141 pref. and 5,400 ord. shares taken up; £22,541 paid. Mortgages and charges: £3,050.

Alliance Electrical Stores, Ltd. (111,884).—Capital, £25,000 in 47,500 pref. ord. shares of 10s. each, and 1,250 def. ord. shares of £1 each. Return dated February 5th, 1916. All shares taken up; 10s. per share called up on seven pref. ord.; £3 10s. paid; £24,996 10s. considered as paid on 47,493 pref. ord. and 1,250 def. ord. shares. Mortgages and charges: Nil.

North Wales Power and Traction Co., Ltd. (78,193).—Capital, £270,000 in £5 shares (10,000 pref.). Return dated January 7th, 1916. 38,100 ord. and 9,200 pref. shares taken up; £5 per share called up on 34,100 ord.; £170,475 paid; leaving £25 in arrears; £66,000 considered as paid on 9,200 pref. and 4,000 ord. Mortgages and charges: Debt of £40,000, secured by issue of £80,000 first mortgage debs., 5 per cent.; debt of £7,000, secured by issue of £7,000 "B" debs., 6 per cent.; debt of £100,000, secured by £100,000 second mortgage debs., 7 per cent. Total debt, £147,000. Total debs. issued, £187,000.

Westinghouse Cooper-Hewitt Co., Ltd. (89,947).—Capital, £30,000 in £1 shares. Return dated December 17th, 1915. All shares taken up; 9s. 6d. per share called up; £14,250 paid. Mortgages and charges: Nil.

CITY NOTES.

Liverpool Overhead Railway Co.

Mr. H. C. Woodward, presiding at the annual meeting on Tuesday, said that they were still under the control of the Government, but the original terms of the arrangement had been modified, inasmuch as the proviso that the compensation payable should be reduced in the same proportion as the aggregate net receipts for the first half of 1914 were less than the aggregate net receipts for the first half of 1913, had been done away with as from January 1st, 1915, and in the place thereof it had been agreed that the company should provide out of their net revenue 25 per cent. of the amount of the war bonus granted in February last to employés who come within the Railway Conciliation Scheme. The bonus to the other employés, and the subsequent increase in the bonus generally, are allowed by the Government to be included as working expenses. The number of passengers carried created a new record. It was attributable to the abnormal conditions prevailing in the Port of Liverpool, whose docks had never at any time been so fully occupied. The receipts did not exactly represent the traffic carried; so many more passengers had added to their takings, but the surplus was not shown in the accounts, the difference having been handed over to the Government to assist in making up the deficiencies of some of the other railway companies. They had placed £4,000 to renewal fund and added £400 to contingent fund. Owing to the shortage of labour and the difficulty of obtaining adequate supplies of materials certain work in connection with maintenance had had to be postponed, but this would be done immediately opportunity again offered. The Government had agreed that companies so affected would be recompensed in respect of such deferred work. The heavy traffic of the past year had considerably taxed the accommodation of their rolling stock, particularly at certain times of the day, and in the hours of heaviest traffic a three-minutes' service was in operation, and some inconvenience had been inevitable. The Great Central Railway Co. had acquired the land for the Seaforth and Sefton railway. When this new railway was connected with theirs at Seaforth the interchange of traffic should prove beneficial, and, provided that Liverpool docks and shipping continued to prosper, he hoped that the results put before the shareholders this year might at least be fully maintained in the future.

Newcastle and District Electric Lighting Co., Ltd.

The gross profit for 1915 was £34,439, plus £14,617 brought forward. Interest on debentures and loans was £18,474, leaving £30,583, out of which £2,260 is put to second mortgage debenture redemption fund, £500 to debenture issue expenses, and £27,823 is carried forward. Though the net profit shows an increase, no dividend is expedient, owing to abnormal conditions. Owing to increased costs, the charge to consumers was raised as from the June quarter. Increased power demand has more than compensated for loss due to restricted lighting. A further £2,600 of the 6 per cent. debentures has been redeemed. Capital expenditure during the year was £48,818. Annual meeting: To-day.

London Electric Supply Corporation, Ltd.

The profit for 1915 was £77,688, against £93,234 for 1914. Including £8,824 brought forward, and allowing for debenture interest and debenture sinking fund, £50,992 remains, out of which 6 per cent. is paid on the preference shares, 3 per cent. on the ordinary, £5,000 is put to contingencies account, and £9,050 is carried forward. Units sold 50,757,584, as against 46,343,065; total costs per unit sold .64d., as against .50d. (increased coal and wages). Power supplied for traction, tramway, and industrial purposes increased by 11 per cent. Average receipt per unit sold (lighting and power) .96d., against .94d. in 1914. The expenses of generation increased by nearly 50 per cent. owing to the war. Although *primâ facie* the accounts show for 1914 an excess profit over the two previous years, no provision is made for Excess Profits Duty. The solicitor advises that "an electricity supply undertaking with a tenure expiring in 1931 comes, if need be, under the provision in Section 42 of the Finance Act referring to businesses which may apply for an increase of the statutory percentage in special considerations; and that when all proper adjustments are made, it will be clear that the Corporation is not liable to the payment of such Excess Profits Duty." Annual meeting: Yesterday.

Yorkshire Electric Power Co.

Mr. A. Lupton, at the annual meeting on February 15th, said that the capital expenditure (£3,550 less than in 1914) had been limited to extensions which could not possibly be refused. They would during the first half of 1916 receive benefit to some extent from the sliding scales in force in their agreements. The plant had been run at very great pressure, and maintenance and repairs were in consequence very high. New and larger plant was on order. In July, 1914, they seemed to have turned the corner, and they regretted that a higher dividend could not be paid. They must consolidate and secure their resources as they proposed by increasing the reserve to £20,000. Mr. T. O. Callender seconded the adoption of the report.

South Metropolitan Electric Light and Power Co., Ltd.

For 1915 there is a revenue credit balance of £49,190, plus £5,591 brought forward, and a dividend of 10 per cent. on the company's holding in the West Kent Electric Co., Ltd. Debenture charges are £12,612, 7 per cent. is paid on the first and 6 per cent. on the second pref. shares, £16,750 is put to depreciation account, and a dividend of 4 per cent. is payable on the ordinary shares, leaving £6,605 to carry forward. For 1914 there was no dividend on the ordinary shares. The report gives the following figures, those in parentheses being for 1914:—H.P. connected, 19,389 (15,529); consumers, 6,781 (6,468); gross revenue, £80,576 (£66,792); expenditure, £31,386 (£23,737); net revenue, £49,190 (£43,054). There was a satisfactory improvement in revenue from energy sold, but coal costs were abnormally high, and wages increased considerably. A 5,000-kw. turbo-generator is being added to cope with the demand, and it will be in commission next month. Negotiations with the debenture trustees are pending with a view to defining the obligation of the company under the trust deed as to setting aside sums to depreciations, &c. In the meantime, at the suggestion of the trustees, the £20,000 carried to reserve in 1913 and 1914 has been transferred to depreciation account, although there is no obligation to do so, no dividend having been then paid on the ordinary shares. With Treasury sanction, £10,790 first debenture stock (4½ per cent.) and 15,926 second pref. shares (6 per cent.) were issued during the year. The business of the West Kent Electric Co. has made substantial progress, the gross revenue rising from £1,596 in 1914 to £13,320 in 1915, and the net revenue from £541 to £3,051. Mr. H. E. West has been elected to the board in place of the late the Hon. L. A. Brodrick. Annual meeting: March 1st.

Notting Hill Electric Lighting Co., Ltd.

The capital expended during 1915 was £1,556. The number of consumers is now 4,358, only 20 of whom are supplied at 200 volts. The lamps connected have increased from 234,608 to 238,981 (32-watt equiv.), and the profit (less income-tax) for 1915 was £22,617, as compared with £24,221 for 1914. Revenue from sale of current was £42,419, an increase of £332; the reduction of £1,604 in profit is mainly due to higher income-tax, which was £2,653, as against £1,499. There is put to depreciation, renewal, and reserve £3,000, debenture interest requires £2,267, interest, &c., on the Kensington and Notting Hill Joint Debenture stock takes £4,171, income-tax £2,653,

distributed to staff under co-partnership scheme (8 per cent. addition to wages), which is still working satisfactorily, £253. After paying 6 per cent. pref. dividend, and 5s. per share, less tax, on the ordinary shares, £337 is carried forward. Units generated or purchased, 3,343,269; units sold, 2,436,496; used on works, 18,001; expended in distribution transformers and accumulators, 888,772; public lamps, 53. Annual meeting: February 29th.

London Electric Railway Co. During 1915 the aggregate gross traffic receipts of the five companies to the agreement establishing a common fund, were £4,924,245. The aggregate receipts from all sources were £5,481,144. The amount retained by the companies for revenue liabilities (working expenses, prior charges, reserves, &c.) was £5,029,778, and the balance £451,366 is credited to the common fund. This company is entitled to 26 per cent., and receives £117,355, which, added to £11,547 brought forward, makes £128,902 available for ordinary dividend, an increase of £59,055 as compared with 1914. The dividends were announced in our last issue. Capital expended during 1915, £157,160. The traffic is satisfactory, and shows a substantial growth since the opening of the new Willesden Junction Station of the L. & N.-W.R. The total passengers and the average fare per passenger cannot be given, as the District line is under Government control. Annual meeting: Yesterday.

City and South London Railway Co. This company's share of the common fund referred to above is 2 per cent, and it accordingly receives £9,027. The total net income was £91,780, an increase of £39,830. Interest, rentals, and other fixed charges require £30,253; reserve £10,000, against nothing for 1914; preference dividend £42,500, as against £18,133; and the balance is £9,027. The dividends were stated in our last issue. The year's capital expenditure was £59,104. Arrangements were made to obtain supply of current for working the railway from the Lots Road power station, and the Stockwell power station has been closed down. Annual meeting; February 29th.

Central London Railway Co. This company's share of the common fund is 20 per cent., and £90,273 has been received, plus £15,413 brought forward. The gross receipts increased by £39,159 to £316,527, and the expenditure by £12,164 to £156,523. The net income was £160,004, an increase of £26,987. Interest, rentals, and other fixed charges were £38,131, there is put to reserve £10,000, as against nothing last year, and the preference dividend takes £21,600. The dividends on other stock were stated in our last issue. Capital expenditure during 1915, £35,440. The Treasury consented to the issue of £150,000 redeemable 4 per cent. debenture stock; this has been sold, and the proceeds will be available for the payment of commitments in connection with certain improvements entered into prior to the war. The construction of the Wood Lane and Ealing Broadway extension makes slow progress owing to the war. A year's extension has been granted for exercising the compulsory purchase powers under the Central London Railway Act, 1913. Annual meeting: Yesterday.

Metropolitan District Railway Co. This company being entitled to 12 per cent. of the common fund receives £54,164, plus £13,888 brought forward. The receipts of the undertaking during 1915 were £1,066,247, and the expenses £511,721. Interest, rentals, and other fixed charges required £350,432; there is put to reserve £35,000; the dividends are as stated in our last issue, and £13,952 is carried forward. Capital expenditure of 1915, £17,059. Annual meeting: Yesterday.

Smithfield Markets Electric Supply Co., Ltd. Sir H. S. Leon, presiding at the annual meeting last Friday, said that the increase of £1,355 in the capital account included the balance of the cost of the Diesel plant, in regard to which a satisfactory settlement had now been arrived at with the Diesel Co. The new set, which would be at work in a few months, would enable them to make a thorough overhaul of the existing ones. In regard to the heavy increase in cost of production, their oil contract carried them over last year. It was now double the price, and charges to consumers had had to be raised. The total cost of generation in 1915 was 6 per cent. higher than in 1914. At the quinquennial valuation their rateable value was considerably increased, but on appeal the original figure was restored. Receipts from sale of current were higher, but the total receipts were less, as consumers were disinclined in wartime to spend money on extensions and alterations. The net profit was £324 less than in 1914. A serious accident occurred on 7th inst. One of the compressors of a Diesel engine exploded, killing one man and wounding another. The cause was being investigated.

Bristol Tramways and Carriage Co., Ltd. During 1915 the gross receipts were £512,385, and the working and general expenses and renewals were £413,521, leaving £98,864. After paying debenture interest, carrying £4,364 interest on investments to reserve, paying the preference dividend, and 5 per cent. for the year on the ordinary, less income-tax, £20,000 is carried to reserve fund for contingencies and renewals, and £6,056 is carried forward. The receipts of the tramways department increased by £8,703 (3.63 per cent.), and those of the carriage department by £49,017 (23.39 per cent.). Passengers carried were 60,272,400, an increase of 1,970,815. No fewer than 1,095 of the company's employés joined H.M. Forces. The depletion of the staff necessitated restricted public services. A motor omnibus service between Tewkesbury and Cheltenham has been inaugurated, but other new services remain in abeyance. Communications have passed between the Corporation and the company with reference to the former's purchase option, but without result. As the Treasury has refused consent to any public issue of stock by the Corporation for the purpose of tramway purchase the directors offered for the purchase price to be satisfied by the issue of Corporation stock to return half per cent. more than the market yield of Government stock at the date of the award. The offer has not been accepted, but it cannot remain open indefinitely. Annual meeting: March 2nd.

Rushden and District Electric Supply Co., Ltd. During 1915 the number of consumers increased from 79 to 123; lamps and motors by 6,380 to 11,941; and the units sold were 249,783, nearly 4½ times more than in 1914. The H.P. of motors increased from 101½ to 292½, of which 290½ is let out on hire. The mains have been extended. Maximum load increased by 109 KW. to 183 KW. Revenue from sale of current advanced from £463 to £1,699. The rapid development of the undertaking has called for extensions, and new plant which will practically double the capacity of the works will soon be got into commission. After putting £300 to depreciation, and paying 3 per cent. dividend, £90 is carried forward Annual meeting: March 2nd.

Northampton Electric Light and Power Co., Ltd. The results for 1915 are all that could have been desired. A favourable coal contract covering the earlier part of the year balanced the high prices paid in the latter half. Costs of other materials increased. 31,476 new lamps were connected, making 223,257. 733 H.P. was added in motors, making the total 4,668 H.P. New mains and feeders were laid, and the output was 5,055,643 units, as compared with 3,958,700. The existing station and site leave no room for expansion, and a large site purchased near Nunn Mills has been approved by the Board of Trade. A new generating station will be proceeded with as rapidly as present circumstances allow, also a railway siding for more economical conveyance of coal, &c. The general depreciation account has been increased by £6,750, £665 has been written off motors, and £1,750 added to reserve. After paying 5 per cent. on the preference shares and 6½ per cent. for the year on the ordinary, £3,114 is carried forward.

Kensington and Knightsbridge Electric Lighting Co., Ltd.—The number of houses and shops connected increased by 70 to 5,011 during 1915, and the lamps connected from 488,912 (14,660 KW.) to 510,785 (15,320 KW.). The lighting restrictions reduced the units sold by 9 per cent., entailing a still-larger percentage of reduction in net profit. The available net profit is £11,653, plus £1,629 brought forward. After paying the preference dividends and 7 per cent. on the ordinary for the year, £432 is carried forward. The renewal and reserve fund has been increased by £7,137 to £139,021. Annual meeting: March 2nd.

Para Electric Railways and Lighting Co., Ltd.—The gross receipts decreased from £249,891 in 1914 to £243,483 in 1915. The operating expenses were reduced from £132,491 to £115,309, the net revenue earned in Para being £128,174, as compared with £117,400. The accounts are based upon the legal exchange rate of 16d. per milreis, and £33,205 must be deducted as the actual loss incurred on remittances. After providing also for the London expenses, the balance of operating revenue is £90,759, compared with £106,147 of the previous year. After paying debenture interest and preference dividend, and putting £15,000 to depreciation and renewals reserve, a dividend of 5 per cent. for the year on the ordinary shares, less income-tax, is paid, carrying forward £18,935.

Mexican Tramways and Light Companies.—The "Financial Times" states that circulars have been issued to bondholders of the Mexico Tramways Co., Mexican Light and Power Co., Mexican Electric Light Co., and Pachuca Light and Power Co., stating that in view of the difficulties of the companies caused by the unsettled conditions in Mexico, Messrs. E. R. Peacock (chairman), S. C. Boulter, H. F. Chamen, R. Fleming, A. Hill, H. M. Hubbard, and A. F. P. Roger have agreed to act as a committee for the protection of the bondholders' interests.

Mersey Railway Co.—The auditor has certified that the revenue available for 1915 amounts to £21,442, as against £21,279 for 1914. With the exception of £164 which is carried forward, this amount is distributed thus:—4 per cent. on 1866 stock, 3 per cent. on 1871 stock, 3 per cent on 1882/3/5 stock, and 1 per cent. on the "B" debenture stock. Annual meeting: To-day.

Beauly Electric Supply Co., Ltd.—Mr. D. McGrath presided at the annual meeting last week. Satisfactory progress, with an increase of 10 per cent. in the output, was reported. The profit was £140. A dividend of 6 per cent. was declared, £16 being carried forward.

Bournemouth and Poole Electricity Supply Co., Ltd.—Final dividend on the ordinary shares at the rate of 7 per cent. per annum, less income-tax, making 6 per cent. for the year, as against 7 per cent. for 1914.

Oxford Electric Co., Ltd.—A final dividend of 3½ per cent., less income-tax, is declared, making 6 per cent. for the year, as compared with 6½ per cent. for 1914.

Newcastle-upon-Tyne Electric Supply Co., Ltd.—Final dividend on the ordinary shares 3½ per cent., making 6 per cent. for 1915, as against 5½ per cent. for 1914.

Direct West India Cable Co., Ltd.—Interim dividend at the rate of 6 per cent. per annum, free of tax, for the past half-year.

Halifax and Bermudas Cable Co., Ltd.—Interim dividend at the rate of 6 per cent. per annum, free of tax, for the past half-year.

Mirrlees Watson Co., Ltd.—A dividend of 5 per cent., less tax, is recommended.

STOCKS AND SHARES.

Tuesday Evening.

The incidence of the coming taxation hangs like a cloud over all the Stock Exchange markets. It was very much the same when the 4½ per cent. War Loan was coming; and for six weeks at that time markets were listless, apathetic, depressed. After the Loan had been issued and allotted, financial matters got tidied up, and business improved. So it is likely to be again, because there is plenty of money about for investment, and the only thing which the Stock Exchange really hates and fears is uncertainty.

The most important event of the week, so far as the electrical markets are concerned, is the issue of an appeal to bondholders in the Mexico Tramways, Mexican Light & Power, Mexican Electric Light, and Pachuca Light & Power Companies, who are invited to deposit their bonds, at as early a date as possible, with a committee that has been formed for the protection of the interests of the bondholders. A lengthy circular recalls the statement made by the Mexico Tramways Co. last summer, and quoted on several occasions here, with reference to the difficulties under which the companies were labouring.

Put briefly, the present committee's endeavours will be directed to securing such guarantees as will ensure that the tramways property, when taken back, can be worked with proper protection and under such conditions as will safeguard the bondholders' interests; while questions affecting the Light and Power companies are arising almost daily, and involve matters of policy that call for important decisions. The committee is a strong and workmanlike body, and the deposit of the bonds with the committee may well be recommended to the proprietors.

Prices in this market have been little affected, save for a fall of 4 points in Mexican Light common, by the step thus taken, but for Mexican issues as a whole there has been just a slight demand during the past few days. Affairs in the positions of various companies have reached a pass well-nigh desperate; and as the committee may be able to do something to mend the fortunes of these unhappy concerns, they are deserving of every encouragement and support.

Brazil Tractions have been moving between 53 and 51½, being at the moment nearer the lower point because of a disappointing slip back in the Rio exchange. The rate went just over 1s. last week, only to ease off to 11¾d. The bonds of the Rio Tramways Co., however, are steadily maintained at 88¾ for the Firsts and 73 for the Seconds. The Argentine Tramways group is steady, without showing any particular movement.

The London General Omnibus Co. issued its report early in the present week, and the company's receipts of £2,882,400 are £340,000 less than they were in the previous year, while expenditure was only reduced by £253,000. The dividend comes down from 16 per cent. to 12 per cent., but the latter is paid free of tax, instead of being gross, as it was in 1914, so that the actual shrinkage is less than appears. Underground Electric Income bonds are rather sellers at 85, but the £10 shares are 3/16 lower at 1¾, while the 1s. shares fell back to 5s. 6d.

Railway stocks as a whole are heavy. Two of the steam lines are making new issues of stock—an example which it is thought likely may be followed by others, unless the public reception to the newcomers is not favourable. Which, by the way, is likely enough, because the terms offered are none too tempting. Undergrounds are heavy with the rest; and the adoption of electric traction by the South-Western Railway has had no influence, so far, upon the prices of the stocks. Falling again into reminiscence, it may be recalled that the result of the Brighton Railway's electrification did not benefit the prices of the stocks until some months after the new system had been in operation.

Reduction of dividends in the electric lighting market is emphasised by a decline in the Kensington distribution from 9 per cent. to 7 per cent. Prices in this department are steady, and there is rather more business than usual doing in some of the shares. London Electric ordinary are ¼ lower, but there has been a little improvement in County preference, and these are the only changes on the week, as will be noticed from our share list.

Eastern Ordinary is the firmest spot in the telegraph market, and there is a rise of ¼ in Chili Telephones. Marconis are a trifle easier. New York Telephone bonds continue to be wanted by the Government at 101½. It had been expected that some announcement would be made by Mr. Asquith, in his speech on the Vote of Credit last Monday night, with reference to the amount expended up to the present by the Government in the purchase of American securities, but apparently the figures are not available.

Of the manufacturing shares, Callenders make the best showing, with a rise of 5s. to 11¾. Henleys are also a good spot at 14, the price being, of course, full of the dividend for the "fat" half of the year; anticipation looks for the announcement to be at the usual substantial rate.

British Westinghouse preference again lost 6d., but the market in the shares is not a bad one. There has been a little buying lately of the company's 6 per cent. prior lien debentures, the security for which is admirable; and the price of 102½ carries the £3 interest due on April 1st. Other industrials are firm. The rubber market has gone back a little by reason of a decline in the price of the raw stuff. This led to profit-taking amongst some of those who had been speculating in the shares. Business fell away considerably in volume. Advantage has been taken of the reaction by people who sold shares which they were unable to deliver, and their purchases sufficed to keep the market steady as a whole.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend, 1914.	Price Feb. 22, 1916.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.				
Brompton Ordinary	10	7½	—	£6 18 4
Charing Cross Ordinary	5	3⅝	—	7 2 10
do. do. do. 4½ Pref.	4½	3½	—	6 0 0
Chelsea	5	3⅝	—	6 13 4
City of London	9	12	—	7 10 0
do. do. 6 per cent. Pref.	6	10⅜	—	5 11 7
County of London	7	10⅜	+ ⅛	6 13 3
do do. 6 per cent. Pref.	6	10½	—	5 17 8
Kensington Ordinary	9	6	—	7 10 0
London Electric	4	1⅝	+ ⅛	9 10 6
do. do. 6 per cent. Pref.	6	4½	—	7 1
Metropolitan	8½	2½	—	7 15
do. 4½ per cent. Pref.	4½	3	—	7 10 0
St. James' and Pall Mall	10	6	—	8 6 8
South London	5	3½	—	6 8 0
South Metropolitan Pref.	7	1⅛	—	6 14 0
Westminster Ordinary	9	6	—	7 10 0
Telegraphs and Telephones.				
Anglo-Am. Tel. Pref.	6	1⅛	—	5 19 0
do. Def.	83/6	21½	—	7 14 3
Chile Telephone	8	6⅜	+ ¼	6 5 6
Cuba Sub. Ord.	5	7½	—	6 9 0
Eastern Extension	7	12⅝	—	*6 5 0
Eastern Tel. Ord.	7	127½	+ ½	*6 5 0
Globe Tel. and T. Ord.	6	10½	—	*6 12 6
do. Pref.	6	10	—	6 0 0
Gt. Northern Tel.	22	34	—	6 8 6
Indo-European	13	49	—	6 15 4
Marconi	5	1⅝	+ 3/32	5 8 1
New York Tel. 4½	4½	101½	—	4 8 4
Oriental Telephone Ord.	10	1¾	—	5 18 6
United R. Plate Tel.		5⅞	—	*7 19 0
West India and Pan.	1	1	—	9 10 6
Western Telegraph	7	12⅝	—	*6 4 6
Home Rails.				
Central London, Ord. Assented	4	69	—	5 16 0
Metropolitan	1½	28	—1	4 7 0
do. District	Nil	15	—	Nil
Underground Electric Ordinary	Nil	1½	— 1/32	Nil
do. do. "A"	Nil	5/6	— 6d.	Nil
do. do. Income	6	81⅞	—	*8 2 0
Foreign Trams, &c.				
Adelaide Sup. 6 per cent. Pref.	6	5	—	6 0 0
Anglo-Arg. Trams, First Pref.	5½	4½	—	6 13 6
do. 2nd Pref.	5½	8½	—	7 17 2
do. 5 Deb.	5	79½	—	6 5 6
Brazil Tractions	4	52	+ ½	6 14 7
Bombay Electric Pref.	6	10 xd	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	55	—	9 1 10
do. do. Preferred	—	37	—	Nil
do. do. Deferred	—	34	—	Nil
do. do. Deb.	4½	64	—	6 19 10
Mexico Trams 5 per cent. Bonds	—	42	—	Nil
do. 6 per cent. Bonds	—	57	—	Nil
Mexican Light Common	Nil	25	—4	Nil
do. Pref.	Nil	28	—	Nil
do. 1st Bonds	—	42	—	—
Manufacturing Companies.				
Babcock & Wilcox	14	28	—	5 6 8
British Aluminium Ord.	5	22/-	—	4 10 0
British Insulated Ord.	15	103	+ ½	6 19 6
British Westinghouse Pref.	7½	44/-	—6d.	6 16 4
Callenders	15	11¾	+ ½	6 7 8
do. 5 Pref.	5	4½	—	5 17 8
Castner-Kellner	20	52	—	6 8 0
Edison & Swan, £3 pd.	Nil	7/-	—	Nil
do. do. fully paid	Nil	1½	—	Nil
do. do. 5% Deb.	5	60	—	8 6 8
Electric Construction	6	15/-	—	8 0 0
Gen. Elec. Pref.	6	9⅝	—	6 4 8
Henley	20	14	—	*8 3 0
do. 4½ Pref.	4½	4½	—	5 6 0
India-Rubber	10	9½	—	*12 19 0
Telegraph Con.	20	57	—	*7 8 6

*Allowance made for dividends being paid free of income-tax.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING JANUARY, 1916.

The returns of electrical exports for the first month of the year show an appreciable improvement on the December position, the month's exports having advanced from £349,409 in value in December to £381,599 in January. The electrical imports, on the other hand, fell away in value, the month's business amounting to only £216,407, as against £238,691 in the previous month; the re-exports also receded to £10,612 in value from £24,382 in December.

The improved export total was mainly due to increased telegraphic, telephonic and battery exports during the month; cable export values remained stationary at a high figure, while machinery exports fell off considerably.

A marked decrease took place in machinery and cable import values, and in certain other directions lower values were recorded, while the only noteworthy improvement on the December figures was in telegraphic, telephonic and battery imports. Our most prominent customer during the month was India (£66,000), while France purchased nearly £40,000 worth of electrical material from us; our Australian Colonies and Argentina were also good customers. United States imports fell off as compared with December, as also did Dutch lamp imports.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Destination of exports and country consigning imports	Electrical goods and appliances.	Wires and cables rubber and other insulations.	Electric lighting fittings and accessories.	Electric glow lamps.	Electric arc lamps and lamp parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	2,886	3,757	331	444	1,640	846	3,975	353	856	123	5,102	1,380	21,693
German West Africa	...	...	...	...	...	...	...	...	...	...	...	46	46
Netherlands, Java and Dutch Indies ...	627	10,979	194	...	...	15	990	...	125	68	1,243	2,015	16,256
Belgium	...	136	...	...	...	...	...	...	...	...	...	...	136
France	1,398	184	345	1,574	214	187	10,173	1,238	740	292	9,690	13,337	39,372
Portugal	101	79	...	358	...	18	169	...	28	...	2,515	32	3,300
Spain, Canary Isles and Spanish N. Africa...	266	49	6	182	...	557	2,850	6	21	11	44	68	4,060
Switzerland, Italy and Austria-Hungary ...	1,153	...	...	...	...	649	1,497	...	340	54	413	253	4,359
Greece, Roumania, Turkey and Bulgaria ...	...	107	...	...	...	...	...	107	...	...	...	...	214
Channel Isles, Gibraltar, Malta and Cyprus...	184	28	80	27	...	15	387	...	40	23	286	9,758	10,828
U.S.A., Philippines and Cuba	1,145	...	90	33	...	...	2,577	...	...	...	...	12	3 857
Canada and Newfoundland	160	...	88	474	...	1,285	1,232	...	675	...	...	9,598	13,512
British West Indies and British Guiana ...	210	91	119	62	...	...	196	...	126	...	142	...	946
Mexico and Central America	125	22	53	38	...	...	42	...	...	...	589	...	869
Peru and Uruguay	151	313	...	170	...	9	77	...	314	...	340	...	1.374
Chile	40	131	201	78	...	75	1.372	1.287	66	...	40	58	3,348
Brazil	88	112	165	164	...	114	27	20	382	...	...	...	1.072
Argentina	1,333	2,887	744	582	...	1,610	10,839	2,433	1,796	224	2,315	176	24,939
Colombia, Venezuela, Ecuador and Bolivia...	125	14	53	38	...	139	57	...	...	...	...	512	938
Egypt, Tunis and Morocco	239	342	186	14	...	...	541	254	963	26	879	903	4,347
British West Africa	100	68	109	305	...	47	613	182	...	...	75	124	1,623
Rhodesia, O.R.C. and Transvaal	1,583	1 868	343	893	26	686	3,651	78	271	85	788	256	10,528
Cape of Good Hope	394	5,152	238	288	...	...	1,982	151	156	29	1,304	177	9,871
Natal	529	5,030	461	142	...	10	1,886	329	118	34	...	...	8,534
Zanzibar, Brit. E. Africa, Mauritius & Aden	51	57	19	149	...	...	284	...	54	...	163	152	929
Azores, Madeira and Portuguese Africa ...	...	169	14	111	...	207	684	82	140	...	...	51	1,458
French African Colonies and Madagascar...	...	...	...	...	...	...	...	11	...	...	...	...	11
China and Siam	139	527	982	119	25	467	761	97	150	...	50	27	3,344
Japan and Korea	215	...	...	58	...	215	254	79	649	...	...	7	1,477
India	4,699	17,440	2,190	2,147	490	1,983	16,329	4,909	6,316	752	7,257	1,490	66,002
Ceylon	81	331	57	212	...	111	99	...	210	...	49	...	1,150
Straits Settlements, Fed. Malay States and Sarawak	122	1,157	200	191	...	55	647	547	14	598	6,811	140	10,482
Hong Kong	83	3,039	172	134	...	59	1,901	25	15	17	20	23	5,488
West Australia	243	658	4,095	58	...	5,860	...	...	116	...	...	...	11,030
South Australia	109	2 046	137	161	...	...	486	...	264	...	211	343	3,757
Victoria	1,366	11,031	1,471	365	220	314	3,267	47	391	...	1,215	868	20,553
New South Wales	97	8,330	1,052	887	94	2,982	5,736	4,345	2,854	55	155	765	27,352
Queensland	106	158	76	289	...	89	687	...	3,943	5	224	...	5,577
Tasmania	230	1,315	12	76	...	...	210	...	...	...	50	...	1,893
New Zealand and Fiji Islands	1,060	6,726	1,736	1,270	15	1,133	8,527	...	581	35	10,065	3 926	35,074
Total, £	21,438	84,333	16,019	12,093	2,724	19,737	85,005	16,580	22,709	2,431	52,033	16,497	381,599

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

Russia, Norway, Sweden and Denmark ...	1,450	...	135	105	...	6,729	1,049	1,545	6,806	...	6,196	24,015
Germany	...	...	...	...	...	...	...	...	...	...	...	...
Holland...	...	1,650	45	11,166	1,96'	...	345	...	1,927	...	...	17,094
Belgium	...	...	...	...	...	...	...	...	...	...	...	...
France	440	333	368	577	169	1,067	69	...	6,724	3,284	86	13,117
Switzerland	1,067	...	511	292	...	3,587	3,184	1,309	499	2,618	...	13.067
Italy	...	...	...	...	...	...	1,195	...	...	...	...	1,195
Austria-Hungary	...	...	...	...	...	...	...	...	...	...	...	...
United States	8,449	1,368	4,104	2,045	5,885	9,066	4.198	70,628	11.610	2,022	22,444	141,819
Total, £	11,406	3,351	5,163	14,185	8,015	20,449	10,040	73,482	27,566	7,924	28,726	210,307

Additional imports.—Spain, carbons, £3,806; Japan, electrical goods, £166; fittings, £220; lamp parts, £173; Victoria, bells, £81; Canada, electrical goods, £120; lamp parts, £13; meters, £345; electrical machinery, £1,176.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

Various countries, mainly as above... ...	456	1,723	...	1,615	...	3,107	214	...	335	586	2,576	10,612

TOTAL EXPORTS: £381,599 TOTAL RE-EXPORTS: £10,612 TOTAL IMPORTS: £216,407

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns. Imports are credited to the country whence consigned, which is not necessarily the country of origin.

A TURBO-GENERATOR STEAM CONSUMPTION TEST.

By a Station Superintendent.

Engineering has its trials, more especially in war time, and if it were not for the absorbing interest of the many problems that face the engineer, and give him occasional tastes of pure pleasure in solving them, the profession would easily be an alternative to a suicide club. Perhaps one of the deepest joys is planning and carrying out a steam consumption test. This pleasure was sufficiently marked in the old days when the indicator diagram and the weight of steam used were the chief factors, but the advent of electricity and the accuracy with which it can be measured has deepened the interest in proportion, no doubt, to the increased satisfaction to be derived from a nearer approach to the truth.

Let us suppose we are about to test a 5,000-kw. turbo-alternator. There is much interesting and careful preliminary planning, and to go back to the earliest stages we should consider the drawing up of the specification for the plant. The specification will determine at what time during the maintenance period the test should be taken; usually after a month or two's continuous run of the plant. It will call especially for a guarantee from the makers of a steam consumption per kw.-hour under certain given conditions of: (*a*) Steam pressure, (*b*) steam temperature, (*c*) vacuum, at overload, full load, three-quarters load, and half load. It will describe shortly the methods to be adopted in taking the test, and will say who provides the necessary apparatus, tanks, instruments, etc. The important clause is the one dealing with the guarantee, and some such wording as given below may be adopted.

"Should the steam consumption be greater than at the rate of lb. per kw.-hour at approximately full load, for each and every complete tenth of a pound of steam in excess of a margin of 2½ per cent. a sum of £400 will be deducted from the contract price. Should the steam consumption be less than at the rate of lb. per kw.-hour at approximately full load, for each and every complete tenth of a pound of steam saved beyond a 2½ per cent. margin a sum of £400 will be added to the contract price."

The figure of £400 will naturally vary with the value to the buyer of the gain or loss to him under his peculiar conditions. The contractor will insert the figure for steam consumption in tendering, and a further clause will give the purchaser the option of refusal to accept the plant should the consumption be, say, 10 per cent. above the guarantee.

So much for the specification, and it would appear simple enough to reproduce the conditions specified, to agree on how to take each reading, and to obtain a figure satisfactory to both parties.

To those who would tread this path happily, the writer would, however, sound a note of warning, and indicate that however much both the customer's and the contractor's engineer may have started out with a pure and firm intention to seek the truth, human nature will out, especially with a bonus in sight. So the best of intentions suffer, and things are apt to go awry.

Sad to relate, the writer has known human nature to fall so low as to exhibit a deliberate intention on the part of the respective engineers to hoodwink and deceive each other. However remote a contingency this may be, and the reader will guess its remoteness, it is well to provide for it. So before starting the test the parties should agree: (*a*) on how many readings shall be taken; (*b*) on what corrections are to be applied should the results obtained vary with the specified conditions. In this connection the following notes may be found of use:—

1. *Steam Condensed.*—The steam condensed should in all cases be weighed. This may be done satisfactorily by obtaining two large tanks, each of which will take about 10 to 15 minutes to fill on full load test. If of wrought iron, the tanks should be well stayed to prevent distortion on filling with water, and should be set on a weighbridge, previously checked by dead weights, and supported thereon by timber laid across underneath in a certain marked position. The tanks should be weighed empty and full, and the temperature of the water taken at the time. Care must be taken to mark the water level clearly on each side of the tank when full, and this level must be reproduced by adjustment of the tank support when the tanks are re-erected and supported ready for test.

The two tanks should be placed side by side and the condensate led to them by a pipe branched to each tank, each branch being controlled by a quick-acting lever-actuated valve. These valves should be worked alternately by the customer's and the contractor's man, the former being inclined to cut off the water a shade too soon and the latter a whit too late.

The time taken to fill each tank should be taken carefully, and particular note should be taken, preferably by a chronometer, of the start and finish of the test of, say, about four hours. It will usually be most convenient to stop at a "tank full," provided that the electricity meter reading is taken at the same time.

The correction in the weight of condensate to be applied on account of the variation in temperature between the water as weighed on the weighbridge and the condensate should be agreed upon. The agreement should present no difficulties, as the facts are well known.

2. *Steam Pressure.*—The steam pressure should be taken on the boiler house side close to the main stop valve, and the pressure gauge used should be checked before and after the test by a standard instrument. The steam consumption is affected to a comparatively small degree within the usual variations of boiler pressure, but it is essential as far as practicable to obtain a steady pressure even if it be a little over or a little under that specified. Table I gives the corrections to be applied in this connection, and follows modern accepted opinion.

Pressure in lb. per sq. in.	Allowance to be made, + per cent. − per cent.
170	+ .25
175	+ .125
180	.00
190	− .25
195	− .375
200	− .50
205	− .625
210	− .75

Table No. I.—Showing per cent. allowance to be added to or deducted from the steam condensed for variation in steam pressure. Steam pressure taken as 180 lb. per sq. in.

3. *Steam Temperature.*—The steam consumption of a set such as that under consideration will vary as much as 1 per cent. for every 10 deg. F. variation in steam superheat above 500 deg. F., and 1 per cent. for every 12 deg. F. below that figure. The importance of taking careful and accurate readings will therefore be understood.

The steel thermometer pocket should be located close to the pressure gauge above mentioned, and should extend well towards the centre of the steam pipe. It should be filled with mercury or cylinder oil, and the thermometer should be one that has been calibrated and certified as correct. Further, this thermometer, together with others used on the test, should be tested in boiling water immediately after the official run as a further check.

Table II gives corrections for variations in steam temperature, and is one now commonly accepted, but this is a matter which should be made a subject of agreement between the interested parties before the official test is made.

Degrees Fahr.	Allowance to be made, + per cent. − per cent.
480	+ 2.00
485	+ 1.50
490	+ 1.00
495	+ .50
500	.00
505	− .416
510	− .83
520	− 1.66
530	− 2.50
540	− 3.33
550	− 4.16

Table No. II.—Showing per cent. allowance to be added to or deducted from the steam condensed for variation in superheat. Steam pressure taken at 180 lb.

4. *Vacuum.*—This, perhaps, is the most important point to watch, as a small departure from the specified figure calls for considerable correction. Here again the exact percentage correction to apply to any given variation from the specified vacuum is a matter for research and agreement by those concerned, but Table III indicates fairly closely commonly accepted figures.

Per cent. of atmospheric pressure.	Allowance to be made, + per cent. − per cent.
85	—
86	—
87	—
88	—
89	—
90	—
91	+ 8.00
92	+ 6.00
93	+ 4.00
94	+ 2.00
95	.00
96	− 2.00
97	− 4.00

Table No. III.—Showing per cent. allowance to be added to or deducted from the steam condensed for variation in vacuum.

The exact point at which the reading should be taken is frequently a matter of discussion, and rightly so, as the vacuum varies considerably between the last row of the L.P. turbine blading and the top of the condenser. The contractor's engineer will be found to exhibit a desire to drill the hole well up the exhaust leg some feet above the floor level. He will thus obtain a lower vacuum, and be thus entitled to a larger correction in his favour. On the other hand, by the way, if it is a question as to the condenser itself being of sufficient capacity to give the specified vacuum, he will quietly insist on making his gauge connection close to the condenser inlet. The point to be tapped should be previously agreed upon, and, in the writer's opinion, should, in fairness, always be taken half way between the centre of the turbine shaft and the top row of the condenser tubes. This will generally be found to be approximately floor level in the usual type of horizontal turbine.

The vacuum should be taken by the simplest means; that is a column of pure mercury in a straight tube, of which the height can be carefully measured. It is necessary at the same time to take careful barometer readings, the latter instrument being placed at the same level as the mercury column. If this be found impossible, then the necessary correction for difference in height of the two instruments must be applied. It is always wise to check the barometer from some recognised standard instrument, which may, however, again be at a different level.

5. The electricity generated must be measured by a KW.-hour meter of careful design and manufacture, certified immediately before and after the test for correctness.

With the above main features in mind and other small matters attended to, such as checking the condenser for leakage before and after the run, and agreement as to inclusion of steam or power used on steam or electrically driven auxiliaries, the test may begin.

The most careful and experienced men should be chosen to take the readings of weight of condensate, steam pressure and temperature, the vacuum and the electricity meter, the remainder being told off to take the various readings which will be found afterwards necessary in the continuous operation of the set.

These readings will include:—Temperature of condensate, temperature of circulating water inlet to condenser, temperature of circulating water outlet of condenser, speeds of main plant and auxiliaries, pressures and vacua of air and C.W. pumps.

The men should work in pairs consisting of a representative of the buyer and seller, and they should agree on every reading taken.

Generally four hours' running with a steady load will be found sufficient to obtain the necessary accuracy for a full load test, provided the plant has been running at approximately full load for four to six hours before the test starts—a wise precaution in all tests of this character.

Fifteen-minute readings will be found sufficient, but the time taken to fill each tank with condensate, together with the electricity generated within that time, should be noted separately.

It will be found, with these precautions, that a very enjoyable test will be experienced, and both parties may look to the result with eagerness and confidence.

BRITISH MANUFACTURING AND THE RUSSIAN MARKET.

We refer in our leader pages to an article which recently appeared in *Elektrichestvo*, of Petrograd, from the pen of Engineer P. Gurevitch, on the prospects of electrical trade between Russia and England. The writer says that the interruption of the German importation of electro-technical goods into Russia, which grew from 14,140,000 marks in 1909 to 34,505,000 marks value in 1913, constrained Russian importers to turn for such goods to other countries, particularly England. Unfortunately, however, while Russian buyers, faced with the necessity of filling up the blank that has been formed, are greatly interested in English goods, the English electro-technical industry—with a few exceptions—does not feel any special need of new markets, and, therefore, has not shown any particular interest in the Russian market. The writer says that this lack of interest may be partly due to temporary war conditions, but it is also based, unfortunately, on a variety of causes which are not of a transitory nature. Taking advantage of the information that he has collected, he proceeds to show the causes of the relatively feeble interest of the English electrical industry in the Russian market, after explaining its exports and its position in the world market. Electrical development in England itself is not particularly large compared with that of other countries. This is explained largely by the great prevalence of gas works in the country. England, with its cheap coal, as is known, was the pioneer in the business of gas lighting. At the present time there are 1,622 gas works in England, whilst in all Germany there are but 552; in Russia but 22. Further, in Paris, the output of gas per annum is 500,000,000 cubic metres; in Berlin, 300,000,000; in Vienna, 120,000,000; in Warsaw, 36,000,000; in Petrograd, 19,000,000; and in Moscow, 13,000,000. But every year the output of gas in London makes 900,000,000 cubic metres, that is to say, as much as in Paris, Berlin, and Vienna. Naturally, says the writer, owing to this great prevalence of gas lighting in England, electric lighting is by so much less developed. The use of electric power in London was 110 KW.-hr. per head of the population in 1910-11; in Berlin in 1911-12 it was 170 KW.-hr.; in Chicago, in 1911, 310 KW.-hr.; and so on.

The development of the English electric stations has been hindered not only by the number of gas works, but partly, also, by the fact that in England about 55 per cent. of all the stations are under municipal control, whilst in Germany 25 per cent. only of all the electric stations belong to municipalities. The small productivity of electric stations in London is explained to a certain extent by the fact that they are extraordinarily diverse. This great drawback of variety is also the defect that afflicts Petrograd in respect to its electric power supply. The use of electric equipment in England per inhabitant, according to a German estimate, amounts to about 2 roubles 83 copecks per head, whilst each inhabitant

of Germany spends on electro-technical apparatus 7 roubles 36 copecks. But this relatively small quantity of electro-technical apparatus used in England was not all made in England itself. The importation during the past two years from Germany alone of electro-technical apparatus per annum reached 34,000,000 marks value, which makes about one-fifth of the total quantity of electro-technical apparatus used in England; whilst in Germany, with an annual production of 1,200,000,000 marks, there was an export in 1912 of 272,000,000 marks value (that is, 22.5 per cent. of the production) and in 1913 of 330,000,000 marks value (an increase in the export of 21.3 per cent.), and the export of electro-technical goods from England worked out in thousands of roubles as follows:—

	1907.	1911.	1912.	1913.
Total electro-technical goods ...	34,366	45,619	51,513	71,477
Electrical machines	9,292	16,836	18,400	21,469

It is to be observed in connection with this, that the year 1913 was a very satisfactory one for the English electro-technical industry, for its export, in comparison with 1912, rose by nearly 40 per cent., whilst the increase in the German export compared with 1912 improved only by 21.3 per cent.

The cable industry in England is very highly developed, and is one of the oldest and most flourishing branches of the electro-technical industry. This great consumption in England of cables is explained particularly by the submarine telegraph lines, and so on. Thus in 1913 the export of cables made nearly half, or 47 per cent., of the total English exportation of electro-technical goods, whilst the value of the cables exported amounted to £3,577,663 sterling. Submarine cables alone were exported to the value of £1,903,915; in other words, about a quarter of the total English export (to be exact, 25.2 per cent.) of her electro-technical goods was made up of submarine cables. For Russia, however, this extraordinary development of a branch of the English electro-technical industry in respect to changing over from importation from Germany is not of much importance, for, thanks to the high protective tariff on cables in Russia for some years back, with the active co-operation of foreign capital, this has been so far developed that nearly all the consumption in cables and insulated wire can be covered by the production of Russian factories, at the head of which stands the United Cable Factories of Petrograd, with a capital of 6,000,000 roubles (the last dividend was 15 per cent.), and the Kolchugin Latten and Copper Rolling Works Co., at Keleroff Station, Northern Railway, the production of which in the near future will probably increase, for the capital of this company was lately increased from 6,000,000 to 10,000,000 roubles. The importation of cables into Russia reached in 1913 155,000 roubles value, whilst from Germany the importation amounted to 81,400 roubles.

Russia does not require much of English telephone and telegraph apparatus, the exportation of which from England in 1913 was £290,279 sterling value. As the chief consumer of such apparatus in Russia is the Post Office Department, which orders them exclusively in Russia, the production of these apparatus has so far developed that the needs of the country can be supplied by existing Russian factories, at the head of which stand the Russian L. M. Ericcson & Co., in Petrograd, which recently increased its capital from 2,000,000 to 4,000,000 roubles; the Russian Siemens & Halske Co., capital 5,600,000 roubles, latest dividend 6 per cent.; and the N. K. Geisler Co., of Petrograd, 1,000,000 roubles capital, latest dividend 12 per cent.

The importation of telegraph and telephone apparatus in 1913, according to Russian statistics given in the *Elektrichestvo*, makes a total of only 363,000 roubles. These figures, however, do not agree with the German statistics, according to which, in 1913 there was exported from Germany to Russia, telegraph apparatus to the value of 188,000 marks, and telephone apparatus to the value of 1,079,000 marks; total, 1,267,000 marks, or 583,000 roubles. In 1912, the export from Germany to Russia of these apparatus reached a total of 562,000 roubles, whilst, according to Russian statistics, this importation of telegraphic and telephonic apparatus was in 1912 only 240,000 roubles. Since German statistics are generally very exact, we must suppose that part of the imported telegraphic and telephonic apparatus from Germany are entered in the Russian import list under some other heading. Already the export alone from Germany into Russia is more than one and a half times the whole Russian importation shown in the Russian statistics; while, according to Russian statistics, in 1912 there was imported from Germany only half of the total quantity of imported telegraphic and telephonic apparatus, one-third being imported from Sweden and one-sixth from other countries.

The acquisition of English carbons for arc lamps, for which in Russia, in consequence of the interrupted imports from Germany (amounting in 1913 to 447,000 marks value), at present there is a great want, unfortunately cannot be counted on. In England the production of carbons for arc lamps is even less developed than in Russia, since there is only one factory of the kind. In view of this cessation of imports of carbons from Germany, the exportation of such from England was forbidden with the opening of hostilities, so that England itself imports carbons from Sweden, Switzerland, and so on. In any case, the export of carbons from England in 1913 reached a value of only £10.064. England's exportation of incandescent lamps is also small. In 1913 England's export made £152,456 sterling value. The total English export of incandescent lamps was less than the German export of these lamps to Russia alone. In 1913, according to German statistics, there were exported to Russia 7,669,105 electric lamps with metal filament, value 7,296,000 marks, and 1,539,586 lamps with carbon filaments, value 768,000 marks; total, 8,084,000 marks, equal to 3,709,000 roubles. In 1912 this item was even larger, viz., 8,854,000 marks for metal filament and 617,000 marks for carbon filament, total 9,471,000 marks. Again, the German statistics do not agreed with the Russian, for according to the latter the total Russian importation of incandescent lamps was 3,849,000 roubles in 1912.

The feeble development of English production of incandescent lamps may be partly explained by the fact that only two English factories of electric lamps work with English bulbs. All the others obtain theirs from the Continent, which certainly makes the production dearer. The last fact is seen also in many other branches of English electrical industry, particularly in the production of various equipment material such as porcelain, glass goods, &c., which might often, indeed, be made in England; but, unfortunately, these auxiliary branches of the electro-technical industry are not sufficiently developed in England. The value of the English exportation of arc lamps and projectors was only £14,512 in 1913, whilst into Russia alone Germany exported in that year 12,369 arc lamps, valued at 652,000 marks; parts of arc lamps valued at 79,000 marks; and projectors valued at 500,000 marks; total 1,231,000 marks. England exported in 1913, £51,828 sterling value in parts of arc and incandescent lamps, including £19,737 value to Russia. Electric batteries and accumulators in that year were exported by England to the value of £226,325; but for Russia this branch of English electro-technical industry is, again, of but little importance, for the production of accumulators in the Russian factories can now be almost entirely covered by the national workshops. The importation of accumulators, according to Russia statistics, made in 1913 55,000 roubles value only, but the importation of galvanic batteries, not specially indicated in Russian statistics, from Germany alone, according to German statistics, made a value of 340,000 marks.

Respecting the important group of electro-technical manufactures which is indicated in English statistics under the title "not specially named manufactures and apparatus for electro-technicians," with a total exportation of £1,063,146 sterling, Russia received £16,007 sterling; that is scarcely 1½ per cent. of the total export. In this group, besides various ornamental materials in which England can scarcely hope to compete in Russia with other countries, there are also electrical measuring apparatus, meters, &c. The production of these instruments in England is considerably advanced, and their export into Russia might be increased. In view of Russia's great necessity it increased considerably in 1914.

Of the electro-technical manufactures under the above group, Russia imported in 1913 from Germany alone H.T. electrical apparatus, 8,967,000 marks, against 5,431,000 marks in 1912. Electric apparatus for heating, &c., 321,000 marks; electric signalling apparatus, 667,000 marks; electro-medical apparatus, 894,000 marks; insulation tubes, 273,000 marks; wireless telegraph apparatus, 111,000 marks; electric measuring apparatus, 4,247,000 marks (against 3,143,000 marks in 1912); insulating articles in asbestos, mica, &c., 76,000 marks; electrodes, 173,000 marks; or a total of 35,729,000 marks.

The first position, after the cable industry, in England is occupied by the production of electrical machines; therefore, on this branch M. Gurevitch dwells more fully, especially as in the Russian importation of electro-technical products dynamo machines and electric motors occupy the first place. Therefore, the possibility of increasing the importation of electrical machines from England becomes a question of considerable interest to Russian buyers of that class of goods.

The total export of electric generators and motors to Russia according to the official statistics of England, Germany, and Switzerland was valued at 5,440,000 roubles; but according to Russian statistics, as published in the *Elektrichestvo*, the importation thereof made 9,595,000 roubles. If we add to the 5,440,000 roubles the value of the importation of electrical machines from Austria, Belgium, France, and Switzerland, which made in 1912 only 7 per cent. of the total importation, then this sum would be only slightly increased. It remains, therefore, to suppose that under the heading electrical machines, there is included in the Russian statistics, besides dynamo machines and electro-motors, all other machines driven by electric current, for example, electro-magnetic separators, and so on. Part of the difference may still be explained by the fact that Germany, Switzerland, England, and other exporting countries give the export price, whilst the Russian statistics report the import price, that is, the price of the exporting country, plus the cost of transport, insurance, &c. But certainly the difference of nearly 4,000,000 roubles is not so explained, and it is regrettable that owing to inaccuracies in the figures in the Russian statistics the actual exchange of goods is confused, and one is lead (by using Russian statistical data) to incorrect conclusions. According to Russian data, for example, the importation of dynamo machines and electro-motors is of almost twice the value shown in foreign statistics. The difference, in fact, is nearly half a million roubles more, for in the German export of electrical machines the author has added also the importation of armatures, commutators, &c., which parts in the Russian statistics are classified separately, although to a very much reduced extent compared with German statistics.

Taking advantage of the occasion, M. Gurevitch quotes one more inexactitude in the Russian statistics. These describe as German goods many articles of English, Swiss, and other origin, but imported over German railways because of the intermediate position of Germany, and the same applies to all goods arriving by steamer from Hamburg, which were described in Russia as German goods, although they may be of foreign origin, and only the last part of the way has been covered on a German steamer. Thanks to the foregoing, the importation of electrical machines from Switzerland, which made the solid sum of 1,250,000 roubles, by no means corresponds to the Russian statistics. As these machines were carried through Germany, they were described as German machines. Although, in fact, the importation of these machines from Switzerland is almost twice as large as from England, in the *Elektrichestvo* table they are not noted at all, whilst the importation from Sweden, making only one-tenth of the importation from England, is correctly described, since Swedish machines do not pass in transit through any other country. It may therefore be said with confidence that the importation of electro-technical manufactures from Germany is exaggerated in the Russian statistics, and the importation from other countries is underestimated. The question of the introduction of uniform statistics in all countries had been near to realisation not long before the war, for on the initiative of the Belgian Government, representatives of twenty-nine Powers, including Russia, were to meet in Brussels for the preparation of uniform statistical reports, but on account of the war this congress was not held. It is hoped, however, that this important question for making plain the real exchange of goods of various countries and the part they take in the world's business will be duly considered after the war.

Following this slight digression, made in view of the importance of statistics for establishing the real importation of foreign electrical goods into Russia from foreign countries, M. Gurevitch returns to the original point.

From the foregoing particulars on the importation of electrical machines into Russia, it follows that the Russian market for English manufacturers of dynamo machines and electro-motors was not an important one before the war. Whilst Germany sent in 1913 into Russia 12.6 per cent. of all her export of electrical machines, totalling, with armatures and commutators, 7,867,000 marks, England sent into Russia only 2.7 per cent. of its total export of these machines. Even Switzerland exported these machines to Russia to twice as great an extent as England. Germany, on the other hand, exported six and a half times as many as England. Meantime, dynamo machines and electro-motors happen to be that department in which England, previous to the war, could compete more or less successfully with Germany on the Russian market.

On the causes of this indifference of the English to the Russian market M. Gurevitch dwells in somewhat more detail, having examined the export of electro-technical manufactures from England to foreign Countries. In the distribution of material included in the English official statistics, he divides the countries that are buyers of English electro-technical industrial manufactures into four groups. In the first are the English Colonies, Australia, India, South Africa, Canada, &c. In the second, South American Republics. In the third, Trans-Oceanic countries, Japan, China, United States, &c.; and in the last, European countries. The centre of gravity of English exports lies first in the English Colonies, whence over half of all the English electro-technical manufactures are exported. One-seventh of this export goes to South America; 11/100ths to Trans-Oceanic countries, and one-tenth to Europe. The stronger the competition of other countries was on the European market, and the more difficult became the export there the less interest did the English exporters take in it; because for them, until recently, there was an immense market in the English Colonies, where the English have a variety of advantages compared with other competitors. For export into these countries, the English exporter does not require to learn foreign languages, and for the transport of the goods he uses the immense English fleet, and so on.

The English Press advises the English merchant to turn his attention to these markets, as recently the competition of the German electricians has increased enormously there. The success of Germany in the English Colonies, in the opinion of the English trade Press, is explained to a large extent by the fact that the German merchants maintain large stocks there, thanks to which they can serve clients not only cheaply but quickly, which in many cases is very important for the client; and this, no doubt, explains to a large extent the success of the German firms on the Russian market too.

In view of the great competition of Germany in England, this classical country of Free Trade, recently, with growing frequency, there has arisen a voice on the necessity of introducing protective duties for the English industry. Conservative circles particularly call for these duties, and that such, at the end of the war, will be really introduced is very possible, for they will be particularly useful in the acquisition of fresh revenue.

If, however, England, with these additional duties, is put in a condition to preserve the English Colonies as a market for its electro-technical industry, then the English exportation to South America, which had been for England, after the Colonies, the best market, will doubtless fall away. In consequence of probable difficulties to German exports in the countries with which Germany is carrying on war, the German electro-technical industry will be obliged to devote much more attention to South America than hitherto. But already, before the war, South America was the best market for the importation of German electro-technical manufactures. The Argentine occupied the first position in 1913 in this respect amongst all other countries. If the export of Germany to European countries declines, then she will endeavour to press out the English electro-technical manufactures, at all events from South America. With reduced German prices, and long credit, which the German industry is in a position to give, probably she will succeed.

At the same time, it must still be remembered that in the United States, the question of seizing the South American markets is now greatly considered. The exportation of electro-technical goods from the United States has considerably increased recently. As the United States can become a large provider of electro-technical goods in the future on the Russian market, a number of figures are given by the author showing the business recently done by America. With the proximity of the South American markets to the United States of North America, and the existing good condition of trade, they will doubtless succeed, he says, in pressing out a considerable part of the English electro-technical goods from South America. The Secretary of the Department of Trade of the United States recently advised American financiers and industrialists to follow the example of Germany, and finance various technical projects in South America. Thanks to this system, Germany has acquired not only a profit on the capital owed to the German banks, but also the orders for machines, and so on. It is known, for example, that the A.E.G., not long before the war, completed a majestic, many million project of underground electric lines in Buenos Aires. Whether Germany or the United States obtains the South American market is all one. Undoubtedly the suffering factor after the war will be the English electro-technical industry. It therefore should, in order to fill up the blank from the reduced exportation to South America, seek new markets; and one of such markets, presuming sufficient enterprise on the part of the English, should be Russia. One of the hindrances to the extension of the export from England to Russia, as has been frequently shown in the Russian economic Press, has been the unwillingness of the English to give credit. Now, for Russia, which is still a country very poor in capital, sufficient credit becomes a question of first importance. For its success in Russia the German industry is undoubtedly indebted, to a large extent, to the circumstance that Germany, with the co-operation of her banks, offers Russian buyers extensive and prolonged credit. To the English merchants the German system of trading on credit was, therefore, very objectionable. Recently, however, in the English Press, ever more frequently are seen articles on this topic, and if English industry desires to sell its goods in Russia it ought to make similar concessions to those made by Germany.

Unfortunately, Russia's business people have abroad in respect to payments a very bad reputation. If, however, foreign providers were to make distinctions between various trading firms and factories, &c., in all probability their losses would be less. Most of the insolvencies in Russia fall to trading concerns, whilst insolvencies in the factories are relatively few, for in Russia large concerns prevail. For example, in Russia there are about 1,100 factories or works with the workmen exceeding 500, about 2,300 between 100 and 500, and about 2,150 with staffs of 50 to 100. The risk in giving credit to the first two categories of factories and a considerable portion of the third group is very small, for it is to a very large extent made up of sound concerns, and partly of share companies with large capital. But if it becomes a question of town councils, large electric stations, and the like, then the risk of non-payment is excluded entirely. Whilst as Germany, of recent years, understood the necessity of distinguishing between giving credit to tradesmen and factory owners, and then devoted all her strength to getting into direct business relations with the Russian users of machines and technical goods, in England the direct sale by English factories of machines to the Russian consumer is hampered by a series of causes. In the first place, in English industrial circles there is a complete ignorance not only of Russian, but of many other foreign languages. In Germany even small manufacturers send out catalogues at least in three languages, and often in five or six, including Russian. In England even large houses seldom send out catalogues in foreign languages, as their chief markets happen to be countries where the English language prevails. Further, whilst the German language is pretty well known in Russian business circles, the knowledge of the English language is very rare, which excludes the possibility of, or, at all events, makes very difficult, the use of English catalogues in Russia. In such circumstances, then, English manufacturers being anxious not to incur heavy expenditure do not consider it advantageous to print a catalogue in Russian. Thanks to all this, direct export by English manufacturers is made very difficult, and they prefer to deal with foreign commission houses knowing the English language or with English exporters. Of small exporters as known in Germany, there are but few in England. There are large export houses there that can maintain a large staff of foreign correspondents.

Thanks to such intermediaries, foreign consumers do not get into close relationship with the manufacturers, and this is certainly prejudicial to business, for the manufacturer does not properly realise the special requirements of the buyer in

respect to the construction of the machine for such-and-such an application, and so on. The English manufacturer usually supplies a well-known type and the buyer has either to be content with that or to go elsewhere.

As the English manufacturer exports very little, he is little concerned whether with the aid of advertisements he can make his goods known to foreign buyers, as has been largely done by German industry in Russia. Generally the organisation of the English export trade has been very feeble. Of the necessity of better organisation of export business, there is now a clear conception in the English Press and technical journals. But this will take a long time to effect.

Russia can count in the future on receiving from England only electrical machines, and to a small extent electrical measuring apparatus. It is certainly necessary that English industry should give up its conservative methods of dealing and change over to the more modern methods, for, with normal conditions, the conqueror of the world's market will be the one which provides the necessary goods best, cheapest, and in the most convenient form for the buyer.

BURNING POWDERED COAL.

An article on this subject by Mr. A. S. Mann, in the *General Electric Review*, last year, dealt at some length with the experimental work carried out at the General Electric Co.'s Schenectady plant. One of these experimental applications was to boiler firing, the boiler unit being of the water-tube type and rated at 474 H.P.

The furnace was fitted with an extension front, making a 4-ft. Dutch oven, in the front of which were fitted six feeders and burners, the feeders being each operated by a ½-H.P. motor and drawing their fuel from a hopper immediately above them.

The feeder consists of a 2½-in. dia. screw, tapered down at one end, driven at from 300 to 600 R.P.M., according to the requirements of the furnace; this revolves in a feeder box, and delivers coal to a tee-piece, where it is picked up by the primary or carrying air current, and this apparatus can be placed a few hundred feet from the furnace burners if required, the fuel delivery being controlled by operating the motor rheostats. A screw of the type mentioned will feed 700 lb. of fuel per hour.

In the furnace itself additional air from a blower is admitted at six separate ports, that is, each coal particle encounters six air currents before it passes to the heating surface, these air currents passing across the burning current in order to give a stirring or mixing action. The six burners across the furnace front are arranged to give the air currents issuing from them a revolving action in a counter direction with respect to each pair. These incoming currents almost immediately meet a downward current of hot air, preheated by passing through the firebrick arch, which drives the main current down towards the hearth, which it passes over, curling up and back again from the brick bridge behind the furnace. With this arrangement combustion is virtually complete in 8 ft. travel, even with 200 per cent. or more load. As much as 520 lb. per front foot of furnace has been burned with only 7 ft. between header and floor line; the boiler has carried 265 per cent. load long enough to show that such loads are possible, and 220 per cent. or more can be carried indefinitely, as there are no cleaning periods.

The powdered fuel is burned in suspension; as it travels at 40 or 50 ft. per second, it must be consumed in 1/6th second or so. During this brief interval there is only 1/5th lb. fuel burning even at the heaviest loads, and at no instant is there a greater quantity of coal on fire. With an ordinary grate no coal particle must burn in a short time, the average time for all particles being half an hour, for there is a ton and a half or so of fuel on the grate burning slowly. With the powdered coal furnace, the fire has been started in a cold furnace beneath a boiler full of cold water and with half the coal burning capacity in use, the boiler pressure of 140 lb. has been available in 20 minutes.

A number of boiler trials were conducted, efficiencies being calculated by dividing heat in steam by heat in coal (laboratory test) that produced it. Test No. 11, with 205 per cent. load, which gave 75.7 per cent. efficiency, with 208 c.f. air per lb. coal, and a flue temperature of 724 deg., was the best of the series, and has since been repeated for a week at a time.

This result was obtained by experimenting with the air dampers, air volumes, flue temperatures, &c., and it has been found that the bulk of the air should be admitted through the arch, preheated, and that 200 c.f. per lb. coal represents about the best proportion. The dampers and rheostats being marked, the stoker can accurately adjust coal and air to obtain the most efficient combustion.

In order to utilise the heat in the escaping gases a feed-water heater is being installed in the chimney base; the soot drops in the gas chambers before reaching the chimney.

The three difficulties, which are not serious at light loads (140 per cent. or less), are slag, ash, and burned brickwork. A furnace temperature of 2,700 deg. F. is met with, and ash becomes slag (114 lb. per ton), and is run into a concrete pit containing water, from which it can be removed with pick and shovel.

About 2 per cent. of fine ash (a white powder) passes out of the chimney. Under heavy loads particles of slag will travel with the gas current and adhere to the first cold surface they meet, the bottom row of tubes, eventually choking the gas passages. This is overcome by admitting a little steam with the air; 140 lb. per hour is enough for 160 per cent. load, or 24,000 lb. of steam per hour. The slag is also blown off the tubes with a steam jet once a day. Most of the soot goes over into the back chamber and is washed out every other day.

The furnace is virtually surrounded by air passages, and heat that gets into them is returned to the furnace.

The air passages and deflecting air currents do much towards protecting furnace walls.

One arch was burned out in six months, being melted down from nine to four inches thick, but it was made of common firebrick. It is possible that it would pay to use carborundum for this purpose.

As to the cost of pulverising coal, a figure of 24.5 cents per short ton is given, including fixed charges, which would be reduced by a third with large plants. Two years' experience have shown that repairs are no greater than in all coal-handling machinery.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

1,773. "Sparking plugs." W. A. Clark, H. G. Longford & W. W. Longford (trading as Sphinx Manufacturing Co.). February 7th.
1,774. "Terminals." R. E. H. Lovelace. February 7th.
1,778. "Electrical apparatus for heating liquids." J. F. Barr. February 7th.
1,779. "Electrical apparatus for heating and/or sterilising liquids." J. F. Barr. February 7th.
1,787. "Junction box or sleeve for wireless armoured electric cables." F. H. Davies. February 7th.
1,794. "Portable electric lighting devices." W. R. Adams. February 7th.
1,811. "Electro-magnets for brakes, &c." J. Anderson & G. Ellison. February 7th.
1,821. "Automatic telephone systems." G. H. Bryant, T. M. Inman and Relay Automatic Telephone Co., and F. M. Ward. February 7th.
1,825. "Electric arc generators for high-frequency oscillations." J. Gell. February 7th
1,827. "Apparatus for wireless telegraphy, &c." B. Binyon & C. L. V. Lee. February 7th.
1,861. "Syntonisation by frequency of groups of electro-magnetic waves." M. B. Rodriguez. February 8th.
1,862. "Thermic telephones." Naamlooze Vennootschap de Nederlandsche Thermo-Telephoon Maatschappij. February 8th. (Germany, February 3rd, 1915.)
1,868. "Automatic telephone systems." G. H. Bryant, T. M. Inman, and Relay Automatic Telephone Co. & F. M. Ward. February 8th.
1,869. "Telephone systems." G. H. Bryant, T. M. Inman, and Relay Automatic Telephone Co. & F. M. Ward February 8th.
1,875. "Dry batteries." P. R. Porrill. February 8th.
1,876. "Machine switching telephone systems." Western Electric Co. (Western Electric Co.). February 8th.
1,897. "Sparking plugs." J. E. Evans. February 9th.
1,903. "Electrically-operated alarm signalling device." J. R. Garner February 9th.
1,904. "Alarm signalling device." J. R. Garner. February 9th.
1,915. "Electric radiator or heat projector." S. W. Hamlyn. February 9th
1,921. "Electrical signalling systems." W. A. Sharman. February 9th.
1,920. "Thermostats." C. E. Hearson. February 9th.
1,976. "Electric diaphragm automobile horn." A. W. Hulbert. February 10th.
1,983. "Trolley head replacement devices." H. R. Hayward. February 10th
2,020. "Sparking plugs and method of making same." W. J. Mellersh-Jackson (Champion Ignition Co.). February 10th.
2,028. "Telegraph repeating instruments." T. B. Dixon. February 10th.
2,044. "Wall boxes for electrical switches, plugs, &c." M. Brooks, J. E. Franks and A. E. Reed (trading as Walsall Hardware Manufacturing Co.). February 11th.
2,048. "Manufacture of electrically insulating coatings for metallic wires, &c." H. G. Rule. February 11th.
2,056. "Dry battery." F. P. Baumann. February 11th. (Switzerland, February 16th, 1915.)
2,058. "Dynamo-electric machines." G. Schroeder. February 11th.
2,065. "Radio-telegraphy." J. Bethenod & E. Girardeau. February 11th. (France, February 11th, 1915.)
2,066. "Wireless telegraphy." E. R. Clarke. February 11th.
2,068. "Electro-magnetic driving gear for clocks." J. Lameris. February 11th.
2,085. "Secondary or storage batteries." H. Wade (B. Ford). February 11th.
2,101. "Alarm or indicator apparatus for electric current supply warning systems." G. Chapman. February 12th.
2,114. "Electric switches." R. H. Williams. February 12th.
2,132. "Electric battery lamps." G. B. Jones. February 12th.

PUBLISHED SPECIFICATIONS.

1915.

722. Safety Devices or Vacuum Relays for Electric Circuits. Siemens Schuckertwerke Ges. January 16th. (January 16th, 1914. Patent of Addition not granted.)
1,093. Regulation or Control of Electric Currents. J. Stone & Co., and A. H. Darker. January 22nd.
1,346. Insulation of Telephone Cables. K. W. Wagner. January 27th. (January 20th, 1914.)
1,470. Automatic and Semi-automatic Telephone Systems. Relay Automatic Telephone Co. (formerly Betulander Automatic Telephone Co.) and W. Aitken. January 29th.
1,525. Construction of Electric Batteries. H. F. Joel. January 30th.
1,641. Electrically-driven Clocks. A. Webber & Standard Time Co. February 2nd.
1,670. Treatment of Air or a Gas with an Electric Arc. M. R. A. Samuel. February 2nd.
2,388. Portable Electric Lamps. Wallace Novelty Co. (Fairweather). February 15th.